

Aviation Week & Space Technology

December 3, 1962

Improved Range,
Power Planned
For DH-125

75 Cents

A McGraw-Hill Publication

Vertol/Marine CH-46A
Assault Helicopter



GET TO KNOW K-BOLTS...



K-BOLT the blind fastener with Kaylock reliability

Here's the newest addition to Kaylock's line of quality fasteners

- 1—Has superior clamp-up characteristics
- 2—High resistance to vibration and fatigue
- 3—Easily installed from one side of work surface
- 4—Reduces assembly time and related costs
- 5—Standard in-stock installation tools are used
- 6—Conforms to proposed Aerospace specifications



Designed for structural applications, K Bolt unit assemblies are available with Hex or Flush Heads, in nominal shank diameters. Write today for Bulletin 2622.

KAYLOCK MFG. CO., INC., 6013 ROCK SPRING DR. • Box 3000, Torrance Area, Los Angeles 54, California

Photo of airport skid landing system

YOU'LL NEVER SKID AGAIN

with the Exclusive Goodyear Adaptive Brake-Pressure Control

AND HERE'S WHY: It automatically regulates brake pressure just below the skid point — instantaneously adapts the pressure of the brake to the coefficient of friction between the tires and any runway surface — constantly adjusts its own sensitivity to the runway condition changes throughout the landing. And it's not affected by overpressure/overheat of the braking system.

There are three great Goodyear Anti-Skid Systems:

Adaptive Brake Pressure Control is the latest skid control system by Goodyear. Another Goodyear Anti-Skid System lets the pilot control braking pressure when a skid develops — then automatically "dumps" pressure until the skid condition is corrected. And the **Skid Warning System** tells a pilot

when a skid is imminent by a sharp "dumping" action so his foot pedal demands his immediate attention and permits the pilot to correct for skids by releasing brake pedal pressure.

Goodyear skid control systems are used on Republic's F-105, Douglas' DC-7, Lockheed's 747 and F-104, Cessna's 441, the Vickers Viscount and many other planes. For more information on these systems, write on your company letterhead to The Goodyear Tire & Rubber Company, Aviation Products Division, Dept. X-1751, Akron 16, Ohio.

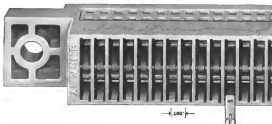
Less of good things come from

GOODYEAR

BURNDY

MAKES ALL TYPES OF ELECTRICAL CONNECTORS

New! .100" spaced PC connector with crimp-type terminations



Burndy's new .100" spaced HRRN™ post-on™ series features crimp-type, removable terminations (automatically installed). Tooled for quick delivery of the most popularly specified sizes... 15, 22, 30 and 43 positions.



- Wire Terminal Lock**—holds contact securely in place. Simple extraction tool inserted from rear releases terminal.
- Spring Contact**—flexible wire gold plated beryllium copper. Permanently installed in connector body for maximum protection.
- Shield Entry**—on board side protection shields against probe damage and wiretags worst fears.
- Wire Terminal**—gold plated, matched with Burndy wire-on™, also bend tool. For double sided boards, double contact on each wire.



BURNDY
Network Connect

AEROSPACE CALENDAR

(Continued from page 5)

- Jan. 14-15**—North Atlantic Meeting, American Astronautical Society, Statler Hilton Hotel, Los Angeles, Calif.
- Jan. 21-23**—11st Annual Meeting including Weight Builders' Luncheon, Institute of the Aerospace Sciences, Hotel Astor, New York, N.Y.
- Jan. 21-24**—14th Annual Meeting, American Meteorological Society, New York, N.Y.
- Jan. 22-24**—North Atlantic Symposium on Suborbital and Orbital Flight, Western Palace Hotel, San Francisco, Calif.
- Jan. 25-26**—7th Annual Army Aviation Conference, Services Symposium, International Inn, Washington, D.C. Sponsor: National Astronautical Services Assn.
- Jan. 30-Feb. 1**—Fourth Annual Solid Propellant Rocket Conference, American Rocket Society, Bellevue Stratford Hotel and The Franklin Institute, Philadelphia.
- Jan. 30-Feb. 1**—National Winter Conference on Military Electronics, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.
- Feb. 1-6**—Symposium on Engineering for Space Sciences, Pasadena, George Washington of Technology, Pasadena, Calif.
- Feb. 5-7**—Advances in Microelectronics, American Society of Test and Measurement Engineers, Park Sheraton Hotel, New York, N.Y.
- Feb. 6-7**—7th Midway National Aerospace Standards Conference, at the Americana Hotel, Los Angeles, Calif.
- Feb. 14-15**—Third International Symposium on Cometary Electronics, UNESCO Building, Paris, France. Sponsor: International Scientific Radio Union, Office of Naval Research, La Jolla, California. National Defense Electronics Association.
- Feb. 15-16**—Space Vehicle Thermal and Atmospheric Control Symposium, conducted by the Astronautical Sciences Division, Emerson Club, Dayton, Ohio. Sponsor: AEC's Flight Aeronautics Laboratory.
- Feb. 22-24**—14th International Solid State Circuit Conference, Philadelphia, Pa. Sponsor: Institute of Radio Engineers, American Institute of Electrical Engineers, University of Pennsylvania.
- Mar. 1-5**—Propulsion Meeting, Institute of the Aerospace Sciences, Cleveland, Ohio.
- Mar. 11-15**—On-line Propulsion Conference, American Rocket Society, Eisenhower Hotel, Colorado Springs, Colo.
- Mar. 18-20**—Space Flight Testing Conference, American Rocket Society and Institute of the Aerospace Sciences, Coast Plaza Inn.
- Mar. 18-20**—1967 Western Pacific Audiocon and Congress, Pacific Audiocon and Ambassador Hotel, Los Angeles.
- Mar. 18-20**—Annual Air Force-sponsored Symposium on Burner Behavior, Hotel, Dayton, Ohio.
- Mar. 21-25**—International Conventions, Institute of Radio Engineers, Waldorf Astoria and Colburn, New York, N.Y.
- Apr. 1-5**—Fourth Annual Symposium and Microelectronics, American Rocket Society and Institute of the Aerospace Sciences, El Merido Hotel, Palm Springs.

(Continued on page 9)

HEAT EXCHANGERS IN A HURRY



(Or: A new slant on $q = \frac{1}{2} \rho (u_1 - u_2) A$)

Heat exchanger design problems are reputed to make young men gray and older men bald. It thus goes as pay to report that Budd heat transfer engineers are today retaining whatever mental alertness they started with. You can profit hereby. Budd offers enough in design, principle and production services for plate-fin heat exchangers. We produce these compact, lightweight and highly efficient exchangers by both dip-brazing and spray bonding... with aluminum, stainless steel, copper and other materials... in myriad configurations for marine cooling, condensers, air coolers, air conditioning systems and other land, sea, air and space applications.

What's new about that? Don't that? To design the best heat exchanger for a given job, a number of non-specified variables must be considered: fluid velocities, heat transfer rates, pressure drops, transfer areas, hot- and cold-side temperatures, etc. ... are usually jangled around until the required heat transfer rate is attained. During this labor, the designer must also find a way to satisfy such vital external requirements as size, weight, strength, reliability, and cost.

We now announce, as modestly as possible under the circumstances, that Budd is developing new techniques that enable plate-fin compound heat exchangers to be designed and produced faster than ever before!

That is not the result of an overnight revelation. Our Environmental Control Systems Department has long been busy with a fresh and deep-probing investigation of ten-

lytical approaches to heat exchanger design. Their study was possibly abetted by the experience, the knowledge of practical operating conditions, and the voluminous test data we've accumulated in over 20 years of designing and producing complete heat exchanger systems, as well as component exchangers and other types of environmental control systems.

Our new design method enables us to fix exchanger exchanger relationships and values with surprising speed. In several recent cases, we've designed complex new exchangers in a few hours!

How do we do it? The details we figured. But we can say that design reliability as well as speed is assured by a pre-engineered flexible design technique. (In a moment of flamboyance, we'd tagged the new method "Pre-engineered Design." It may stick.) Other enticing information is contained in our best on exchanger bulletins, which we'll naturally send on request. (If you don't already belong to The Budd Inventions Club and Marketing Society, we can see to ask for your membership card right now.)

There is, of course, an immensely sensitive way to verify our rather substantial claim—let us design and deliver your next exchanger. Why not? Environmental Control Systems, Budd International, 48-35 Queens Rd., Long Island City 1, N.Y.

Representative literature shows data in greater specific information than that shown here. Inquiries to Budd mean, whether you're an engineer or not, a 100% reliable maximum efficiency 100% service.

Design, Production & Distribution of
All Systems • Earth Sciences
Environmental Control Systems
Environmental Control Systems Eng.
Reliability Eng. • Heat Eng.

Budd
ELECTRONICS
A DIVISION OF THE RUOD COMPANY, INC.

CEMCO MOTORS



THE THREE STAGES OF MINUTEMAN

depend upon three auxiliary power packages. Each is driven by a small-size big-output motor capable of delivering the order of reliability and performance demanded for Minuteman. They are products of Eerac Division of Electronic Specialty Co., which has been providing missile, space, and aircraft industries with custom motors, actuators, and starter-generators for 30 years. For complete, specific information on Eerac Minuteman-proved products, just write or call.



GENERAL REQUIREMENTS:

It should come upon either an approved design, Eerac and final customer design, or a customer design. Eerac will design and build to customer design. Eerac will design and build to customer design. Eerac will design and build to customer design.

SPECIFIC REQUIREMENTS:

1. Size (Power/Weight) 2. Voltage 3. Speed 4. Torque 5. Life 6. Temperature 7. Humidity 8. Shock 9. Vibration 10. Altitude 11. Pressure 12. Radiation 13. Corrosion 14. Sealing 15. Mounting 16. Control 17. Testability 18. Reliability 19. Maintainability 20. Cost

3. Size (Power/Weight) 4. Voltage 5. Speed 6. Torque 7. Life 8. Temperature 9. Humidity 10. Shock 11. Vibration 12. Altitude 13. Pressure 14. Radiation 15. Corrosion 16. Sealing 17. Mounting 18. Control 19. Testability 20. Reliability 21. Maintainability 22. Cost

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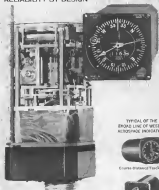
ELECTRONIC SPECIALTY CO. - Eerac Division • 4100 W. Jefferson Blvd., Los Angeles 16, Calif. • 913-411-1111

AEROSPACE CALENDAR

(Continued from page 7)

- Apr. 24-25-Eighth Annual Business Aircraft Safety Seminar, Flight Safety Foundation, 1000 Rockefeller Plaza, New York, N.Y.
- Apr. 24-Spring Conference, Airport Operators Council, Sheraton Hotel, Washington, D.C.
- Apr. 30-31-Fourth Symposium on Engineering Aspects of Manpower Development, University of California Berkeley
- Apr. 15-17-Hypersonic Ramjet Conference, American Rocket Society and American Society of Mechanical Engineers, Naval Ordnance Laboratory, White Oak, Md.
- Apr. 17-19-International Navigation Meeting, Conference, Sheraton Hotel, Washington, D.C. Sponsored American Institute of Electrical Engineers, IRE
- Apr. 17-Rheotronics Conference and Electronic Motor Institute of Radio Engineers, Dallas Memorial Auditorium, Dallas, Tex.
- Apr. 17-18-Technical Meeting, Nuclear Vehicle for Space Applications, American Nuclear Society, Sheraton Hilton Hotel, Columbus Ohio
- Apr. 22-23-Annual Meeting, National Automatics Society, Washington, D.C.
- Apr. 22-24-Second Minuteman Space Flight Symposium, Institute of the Aerospace Sciences in cooperation with NASA and AFSC, Dallas, Tex.
- Apr. 22-24-Tenth Annual San Diego Symposium for Biomedical Engineering, Del Webb Convention, San Diego, Calif.
- Apr. 24-26-Ninth Annual Electronic Components, Instruments, and Radio Engineers, San Diego, Calif.
- Apr. 29-30-31-Annual Conference, Society of Photographic Scientists and Engineers, National Hotel, Atlantic City, N.J.
- Co-sponsor: Army Research Office
- May 1-3-Ninth Annual Conference, American Rocket Society and Aerospace Modelers, Los Angeles, Calif.
- May 2-5-Fourth National Symposium on Plasma Physics in Electronics Institute of Radio Engineers, Maytag Hotel, San Diego, Calif.
- May 7-8-Electronic Components Conference, Institute of Radio Engineers, Maytag Hotel, San Diego, Calif.
- May 11-12-National Automatics Electronics Conference, Institute of Radio Engineers, Dallas, Tex.
- May 14-17-Cosmosat, General Flight Pattern, Second National Symposium on Air Transportation, Hartford, Conn.
- May 22-24-National Symposium on Mechanics, Theory and Techniques, Institute of Radio Engineers, Maytag Hotel, San Diego, Calif.
- May 20-22-National Telemetry Conference, Hilton Hotel, Minneapolis, Minn.
- May 22-24-Sixth Army Computer Conference, American Federation of Informatics, Princeton, Princeton, Calif. Hall, Princeton, N.J.
- May 27-28-Sixth National Conference on Product Engineering & Production, Institute of Radio Engineers, Continental Hotel, Cambridge, Mass.
- June 11-12-13-International Air Show, Le Bourget, Paris, France

RELIABILITY BY DESIGN



TYPICAL OF THE BROAD LINE OF WESTON RECORDING INSTRUMENTS



Course-Related Tracking



Continuous Target Altimeter



Seismic Display



Beating Distance Reading



Beam Monitor

MEMORY

ONLY INSTRUMENT OF ITS KIND - HAS INDEX FOR AUTOMATIC CONTROL is what makes it all on level you can depend on Weston aerospace instruments for highest reliability and superior performance. This complex memory device, available in many sizes, provides an accuracy of $\pm 0.5^\circ$ on the card and is employed with an adjustable memory index for automatic flight control. Reliability is proved in over 1,000 hour MTBF tests - better than by time tested under normal flight conditions.

Weston's high performance memories are achieved through precision packaging techniques and mechanical design in plant manufacturing and rigid quality control. In addition, Weston offers sophisticated engineering assistance. We designed and built the original LRS indicators, and recently supplied some of the 26 indicator assemblies aboard each Mercury Decade.

Take advantage of unusual Weston design and development capability. For more information write Weston - producer of the most complete line of electrical aerospace instruments for manned flight. Dept. AW-42.

Weston Industries Division of Electronic Division

WESTON INSTRUMENTS

Division of Dayton, Incorporated, Newark 16, New Jersey

Aerospace Instrumentation • Remote Transmitters • Observation & Test Equipment • Photographic Aids • Photocopying • Production • Precision Metal Film Resistors • Relays & Telemeters • Systems Design & Development

Announces

CLEAR LAKE CITY

A major research park, industrial park
and totally-planned community
--next to NASA/Houston

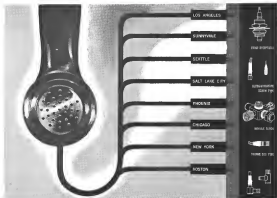
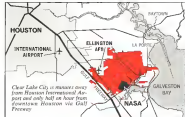
NASA/Houston recently announced acceleration of its \$150 million construction program. By late 1963, operations will start concentrating at the Manned Spacecraft Center and its nearby Ellington AFB. Clear Lake City bridges these two NASA nerve centers.

The Industrial Park, with identical improvements and controls, will adjoin the Research Park on the south. An Industrial District will be located in the northwest.

Northeast of Clear Lake City, 7000 acres are to be developed for heavy industry by Humble Oil & Refining Company.

Clear Lake City is a project of Del E. Webb Corporation for Friendship Development Company.

Del. E. Wynn, Cooperator



**Avnet offers you 8 sources
for the complete line of Microdot Connectors
-with 1 phone call!**

Discuss your requirements on Microsoft Connectors with any of the 8 Annet Offices listed below. When you phone your local Annet Stacking Facility, you are — in effect — talking to 8 sources at one time.

AVNET

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THE ABOVE, CAL. 113 87 1000; SUMMARY: CAL
AND AN OTHER SOURCE: NAME: AND AN OTHER SOURCE:
NAME: AND OTHER: LAST NAME: LAST NAME: AND OTHER:
ADDRESS: 113 87 1000; ADDRESS: 113 87 1000;
AND AN OTHER: ADDRESS: 113 87 1000;



Teaching Machine

Hughes 269A Helicopter combines all the features of the "perfect" trainer. Consider these facts:

1. Designed for training ease—Pilot who has "flown these 60" knows the 269A for its responsive controls, very high maneuverability, unusual stability, 600' visibility, high rotor clearance—overall compact size.

2. Costs less to buy, less to fly—First cost of the 269A—\$92,000—is at least half that of previous helicopters. Continued operators report all direct operating costs are as low as \$10.00 per hour. Some operator reports its maintenance parts and labor record of just \$3.00 per hour through 475 flight hours.

3. Proven in U.S. Army and Air Force evaluations—The HO-3 Hurry program for the 269A prototype and its modified all gunships for a light gunship helicopter program. The 269A's high power to weight ratio, great rotor diameter, rugged structure, small footprint and wingtip clearance.

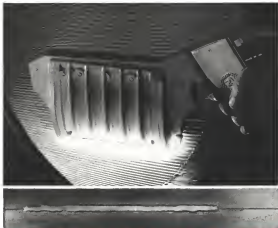
4. Minimum maintenance, maximum air time—The 269A did not make "up front" because it spends less time in the shop. Its simple, wear-out parts in major components have a life of at least 1000 hours. Hughes re-

ports show a ratio of three hours of flight time to one hour of maintenance.

5. "On the spot" delivery—The Hughes 269A is now in full volume production at Hughes Tool Company's Aeronautics Division facilities. A world wide dealer network offers complete sales, service and training support.

6. Outstanding Specifications for the Hughes 269A, rotor diameter—50'. Overall length—32'. Overall height—64'. Max. Power by Lycoming 160 hp 6-cylinder, Gross speed—130 mph. Range—200 miles. Endurance—2 hours.

For more information on the 269A and its unusual capabilities as a trainer, please contact the Vice President, Marketing, **Hughes Tool Company**, Aircraft Division, Culver City, California.



VERSATILE INFRA-RED BRAZING TOOL HANDLES PRECISION WORK AT TEMPERATURES UP TO 2100°F.

Electric powered and time-controlled, Aerdjet's new Aerdjet Brazing Gun* offers far more control over heat brazing operations than ever before possible. Developed to perform delicate repairs to thin walled sections (.010 - .030 inch) of missile thrust chambers, the gun focuses high density infra-red energy into a 5 inch line only .150 inch wide, delivering time-controlled temperatures up to 2100° F. The Aerdjet Brazing Gun has a power density output of 2400 watts per square inch, and can melt a brass alloy such as Coast 402 in less than 45 seconds. This speeds up brazing dramatically and permits use of inexpensive brass alloys. Just as important, close control of the heat output reduces discoloration and all but eliminates accidental burn damage to the part. Made of aluminum, the Aerdjet Brazing Gun weighs only 3 pounds. Operation is so simple unskilled personnel can be trained in about 15 minutes. Power requirement is 230 volts A.C. Heat is generated by a standard quartz lamp and focused by reflectors. Brazing takes place in an envelope of argon gas triggered through the gun. Price of the complete Aerdjet Brazing Gun (including timer), \$975.00 plus shipping and handling. For more information, contact Aerdjet General* Corporation, P.O. Box 996—F, Dept. 55, Azusa, California.





HERE IS A PROJECT THAT FOLDED.

In more ways than one.

The Hiller "CAMEL" may never log one second of air time. It is one of a number of exploratory projects which Hiller has sponsored over the years to make tomorrow's flying helicopters more useful and reliable.

In 1959 Hiller military requirements engineers teamed with Army combat experts to explore thoroughly the problem of transporting tactical

helicopters into remote theaters of action, quickly and with minimum logistical support. The CAMEL was one of the results — a turbine helicopter with eight-minute foldability.

Company-financed research programs, like the CAMEL, often don't reach flight status, but their ideas do—in such aircraft as the Hiller Teo90 and U.S. Army HO-4S Light Observation Helicopter. Two of the world's most advanced rotorcraft.

U.S. ARMY SOLD

HILLER TEOS90

IDEAS AND CONCEPTS—RESEARCHER DESIGNERS

HILLER
AIRCRAFT COMPANY
DAVID ALDO CALIFORNIA • WASHINGTON, D.C.
DIVISION OF THE ELECTRIC AIRCRAFT COMPANY



Army XV-5A* provides maximum range/payload

Scheduled to fly in mid-1963, the Army XV-5A* lift fan research aircraft will provide greater payload/range capability than any other high performance V/STOL system.

Now being designed and built by Ryan Aeronautical Company, under contract to General Electric, the XV-5A* aircraft will be powered by two J85 jet engines which drive submerged wing fans for vertical flight. This unique concept provides two to three times more lift, for a given amount of installed engine thrust, than any other high speed V/STOL design.

Result: Greater payload/range capability—less fuel consumption and need for logistic support. Because the lift fan system multiplies engine thrust by 300 percent, for vertical flight, XV-5A* engines can be used for most efficient hovering and cruise conditions and do not have to be oversized to meet V/STOL flight requirements. These inherent and designed advantages gave the XV-5A* performance which meets anticipated requirements for military missions.

* FORMERLY XV-42

RYAN AERONAUTICAL COMPANY, SAN DIEGO, CALIFORNIA



Conventional XV-5A cockpit permits pilots to fly through maneuvers without moving head or feet control problems.

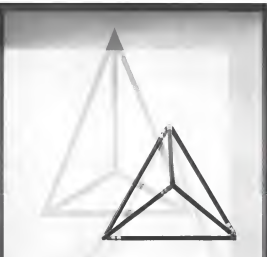


Low velocity and low temperature of lift fan offers major advantages for operation from unprepared sites.

RYAN
AEROSPACE

RYAN'S SPECTRUM OF CAPABILITIES

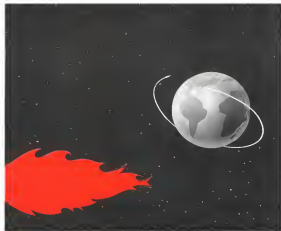




Achphenomenon

Somewhere between the problem of forcing six pencils into four equilateral triangles and seeing the solution as a tetrahedron...Achphenomenon occurs. Call it insight, inspiration, perception. It is that sudden impulse to think in another direction. Such impulses have produced our greatest achievements. The creative efforts of our scientists and engineers have effected unique solutions in aerial technology, establishing us as the world's leading producer of aerial guidance systems for aircraft. We welcome original thinkers with fresh thoughts for our fields of endeavor: stable platforms, gyros, airborne computers, associated electronic equipment. If you have new configurations in mind, send a résumé to Mr. J. A. Lacy, Manager Professional and Scientific Staffing. You may expect prompt attention from Litton Systems, Inc., an equal opportunity employer, located at 8000 Canoga Avenue, Woodland Hills, California.

LITTON SYSTEMS, INC. GUIDANCE AND CONTROL SYSTEMS DIVISION
 GUIDANCE SYSTEMS • CONTROL SYSTEMS • COMPUTER • COMPUTER CONCEPTS



A world of CUSTOM COATING SERVICE for the "hot" wear problems of aerospace!

A new era of high temperature and wear resistance for aerospace working surfaces has been "ordained" by LINDE's Complete Custom Coating Service!

Every coating facility—from metallurgical research through development, production, and testing—is available for the application of coatings of tungsten carbide, aluminum oxides, and pure metals to provide top thermal resistance and optimum service life.

LINDE—the "one stop" coating source—evaluates and specifies the right material and coating thickness, the right coating process—either LINDE's Flame-Plating "deposition gun" technique, or Plasma-Plating with its operating temperatures ranging up to 30,000° F.

With the industry's widest experience in metal-to-metal coatings, LINDE's Complete Custom Coating

Service has the answer to your "hot" wear problem—regardless of the basic material, size, or configuration of the piece involved. If the answer isn't on our shelf—we'll research to get it!

Many of today's important aerospace parts have successfully used Plasma Plated coatings—such as the combustion chamber of the Agena satellite rocket engine, aircraft valves, compressor blades, turbine engine nozzles, rocket nozzles, and many others. For many industrial parts, LINDE's "prescription" coatings have increased service life as much as 40 times!

Write for full information today—to Plasma Plating Dept., Linde Company, Division of Union Carbide Corporation, 1245 Main St., Indianapolis 24, Ind. In Canada: Union Carbide Canada Limited, Linde Gases Division, Toronto 18.



FLAME-PLATING: TOMORROW'S COATINGS... FOR TODAY'S WEAR PROBLEMS

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We repeat—

G-E Tungsten & Molybdenum product possibilities extend to...



Get a fresh slant on two metals with a promising future!

Send for complete tungsten and moly technical data for your "brain file". G-E Lamp Metals and Components is probably your best single source anywhere for any form of these two versatile refractory metals. Only General Electric gives you three classes of moly sheet, flat rolled tungsten and moly up to 2 ft. wide, pressed and sintered products—preforms, thick-wall tubes and crucibles—metal powder, wire, rod, and vacuum metallizing wire and filaments. What's more, General Electric engineers are ready to provide "infinite" assistance to help you use tungsten or moly in your application.

We'll include with the technical data on tungsten and moly, this useful Weight Conversion Slide-Rule Calculator—FREE.



Write for your booklet, please, to General Electric Co., Lamp Metals and Components Dept., 11400 Tungsten Rd., Cleveland 11, O.

Progress Is Our Most Important Product

GENERAL ELECTRIC



WHO'S WHERE

In the Front Office

David J. Lewis, local chairman, Mo space Manufacturing Co., Burbank, Calif. Mr. Lewis continues as president.

Dr. Gene Donald L. Pitt (USAF) with a vice president of United Aircraft Corp. He will coordinate all West Coast activities of the company's existing divisions and subsidiaries. Bureau of Aeronautics, General Pitt is president of United Technology Corp., a subsidiary of UAC.

John S. Guback, a director of Motor Inc., Falls Church, Va. Mr. Guback is newly appointed Secretary of the Air Force in Eastern Air Line's vice president position and continues relations.

W. A. Semmes appears as a board member of Vickers Armstrong (Navy) Ltd., he will be director-in-charge of the firm's aircraft division. Mr. Semmes continues as associate director of Hamilton, Aircraft.

Stanley I. Hoffman, president, Division Test and Engineering Co., Los Angeles. Carl H. McRae, vice president, Textron, Elmont Corp., Norwalk, Conn., and director of marketing for the Instrument Division.

William T. Karpinski, vice president-general manager, Universal Mach. Corp. Mr. Karpinski continues as vice president and general manager of Berkeley Electronics Inc., Berkeley, Calif., a subsidiary of Universal Mach.

Dr. F. A. Chown, vice president director of Engineering Sciences, Pasadena Corp., Santa Ana, Calif., a division scientific company and J. W. Wheeler, vice president, Composites Division.

Dr. Harold A. Lennberg, vice president engineering, Houston Fusion Corp., Dr. Lennberg continues as assistant general manager of the company's Westwood Division, Los Angeles, Calif.

Harold Corp. Lady Nick N.Y. has announced the election of its following as new vice presidents at Houston Division to Division J. W. Ems, Jr., marketing; J. W. Wittenberg, for operations; Dr. R. E. Holloman, for engineering; Alan S. M. Thomas, elected sales vice president, the latter International Division.

Raymond Corp., a subsidiary of Hamilton Corp., has elected Donald Williams and Dr. V. J. Stang as vice presidents.

Carl M. G. Wilson, vice president director National Vacuum Inc., and J. M. Wolkoff, vice president manufacturing.

Russ M. Bushman, vice president engineering, Consolidated Systems Corp., Monterey, Calif. and Wm. R. Della, vice president field engineering.

Honors and Elections

Alfred C. Paulick, of the California Institute of Technology, has received the American Rocket Society's Certificate of Appreciation for his first paper submitted the year by a graduate student in the field of astronautics. **Russell H. Wolkoff**, of the Ford and Franklin J. Koshoff, of MIT, received the Society's Undergraduate Student Award for their original paper on experimental research on a composite rocket fuel they developed.

(Continued on page 115)

INDUSTRY OBSERVER

Proposals for a 12,000 cu. ft. "global" ballistic missile system were due last week, from industry. Air Force ballistic Systems Division requested the proposals. The 16 cu. ft. solid-propellant motor motor has been considered as a possible first stage booster for this missile.

Thousand transport V-STOL, being developed by Vought, Hiller and Ryan team as the XC-142 is being proposed for intermediate warfare as one of several Navy missions under study. ASW version would include a torpedo bay big enough to carry two Mk-46 torpedoes. Fusion would operate from carriers, would use a lifting body, vertical take-off, landing, and a two-position landing gear. Weight possibly would be 1,200 lb. total.

Funds for Air Force Systems Command Space Systems Division's "extended" Star program may be shifted to Fiscal 1964, but vehicles used for the aerial satellite-intercept mission may be postponed. Both Space reconnaissance and defense systems are under consideration for funding with equal allocation. Plans also contemplate use of General with new men, with period adjustment for second estimate being used for special equipment.

National Aeronautics and Space Administration may award advanced propulsion system contract for its Apollo lunar excursion module (LEM). The system will use one main and one backup propulsion with shutoff thrust chambers and storable liquid propellants. Development of such system should be responsibility of Grumman Aircraft Engineering Corp., LEM prime contractor, but question of whether Grumman or NASA would manage the backup system was still undecided as the two conducted LEM negotiations at Houston, Tex. Negotiations are expected to be completed before the end of the year.

Thompson's entry plane vehicle designated SuperStar has been proposed by McDonnell Aircraft Corp. to Air Force. Vehicle is designed for sea-to-space transition research in the upper atmosphere at speeds equivalent to escape velocities. It would be a follow-on to the Target Star (ASW No. 26, p. 27) but would be substantially heavier and be capable of passing advanced DynaSoar or Apollo class structures.

Air Force Minute Command may have to rely on a state-of-the-art solid propellant for its Space and missile needs because of the relatively tight schedule projected by the program. Alternative would have been a jet-propulsion engine (continued by a program supported by Advanced Research Projects Agency (ARPA) New 12, p. 23). Competitors for the Space program include Douglas, North American-Columbia and Martin Marietta. Lockheed Martin and Space Co. declined to participate after Lockheed dropped out. Boeing offered to participate but was not selected by ARPA.

Finalists of the 1960s the solid-propellant rocket motor, presently at grade as proposed in the engine in the 1960s, motor by USAF and NASA, 100 in. being studied for a variety of mission by Aerospace Corp. for Air Force's Space Systems Division. One possible mission is an advanced motor for a Titan 1 type of configuration, and one for 120 in. motor version of the two planned for Titan 3.

Third Saturn C-1 launch vehicle flight was marked by good data acquisition, comparable to that of the first two flights. There were 12 losses and two partial losses out of 67 attempted in-flight measurements. Last data included temperature and pressure readings on exhaust gases No. 3, attributed to a broken connection between instrumentation and power source. Two partial-on measurements showed high signal-to-noise ratio, but data appeared unreliable. First Saturn carried 50% measurement power, with eight total and 13 partial losses of data. Second carried 85%, lost five completely and four partially.

Electronic motor system which will be part of the operational Nimbus extracolorial satellite will be flight tested on board Titan 7 if the system is ready by early next year. If not, it will be part of the Titan 5 flight vehicle.



EXTERNAL RADIATION TESTS To bring computer circuit cards into being conducted at the model 60 modulator facility of the University of Michigan. Shown above are circuit cards being inserted in the modulator test cylinder. After the cards are in place, the modulator is closed around it to test cylinder. The servitors (microswitches) of the cards are photographed during irradiation to measure both gamma dose rate and gamma gamma dose effects.

ATTACK SURVIVAL of our Naval forces depends in part upon the ability of shipboard electronic systems to operate after nuclear attack. Using the facilities of The University of Michigan Phoenix Laboratory, Bendix engineers are measuring the effects of gamma radiation on typical shipboard electronic circuits. This is one of a spectrum of Bendix programs covering design of systems tolerant of ionizing radiation from weapons, from nuclear propulsion systems, from nuclear space power systems, and from both natural and induced space radiation. Engineers interested in applications of radiation effects techniques are invited to contact our Personnel Director, Bendix Systems Division, Ann Arbor, Michigan—an equal opportunity employer.

Bendix Systems Division



**WHERE IDEAS
UNLOCK
THE FUTURE**

Washington Roundup

Sylvester's Sunshine Kit

Arthur Sylvester's "good news kit" governing the release of information on military space hearings is only 12 days old but it has already drawn the fire of Chairman John E. Moss of the House Government Information Subcommittee.

News of military launches is strictly restricted by a secret directive, written last spring and since rewritten, and signed by Deputy Secretary of Defense Ronald G. Galt (AW May 21, p. 3). Sylvester, who is assistant chief of defense for public affairs, distributed a "public affairs guideline" telling military subcommittee officers how to use a left bit about a launch without violating the Galt directive. The guideline also encourages "all relations" to forward nonlaunch information to his office for "consideration and public release" insofar as it is "consistent with the protection of security information."

As for launches, if a vehicle gets safely out of sight and sound of ground observers, the fact that the launching has occurred, the type of booster, the launching agency, and the launching site can be released. If the vehicle explodes or is intentionally destroyed on the pad or within sight of observers, that fact can be revealed, plus the information that "an investigation is under way to determine the cause." If trouble occurs after the vehicle is out of sight and sound, however, information officers must apply the no news is good news philosophy, and say nothing.

Rep. Moss pointed out in a speech Nov. 30 that all military launches, "whether they are for a military purpose or to gather information of a scientific nature, are covered by the blanket of secrecy" and said: "All information about the billions of dollars spent by the military in space research is channeled through the Pentagon's single public information voice." He said his committee will do everything possible to generate a wide public discussion of the review for management of news about military space efforts. Presumably this would exclude public hearings only in the next session of Congress.

Rep. Moss also said Rep. George Miller, chairman of the House space committee, "is just as concerned as I am about the growing secrecy surrounding military space activities. [He] has first-hand knowledge of the damage that excessive secrecy can do to our scientific space programs."

U.S.-Soviet Space Pact

Three-part agreement on cooperative U.S.-Russian space projects, now at the White House, is expected to get President Kennedy's signature as soon as he feels the Cuban situation has eased sufficiently. Some space officials believed the President would discuss the agreement in his talk with Soviet First Deputy Premier Alexei Nikolov here late last week (see p. 31).

Scientists hope the agreement can become effective before the end of the year, so Russia can prepare to launch signals off the Eka 2 satellite communications satellite, due for launch in March. Other experiments that have been agreed upon at the working-level deal with weather and geosynthetic sensor satellites.

Committee on the Peaceful Uses of Outer Space, set to report Dec. 3 to the United Nations General Assembly, and it is expected that the subcommittee report on legal aspects of space will be reviewed for further consideration. Agreement on the technical talk-on-space report was announced, but the judicious subcommittee report brought a sharp split along U.S. and Russian lines.

NASA Budget Status

Indrag Dutt and the National Aeronautics and Space Administration have almost completed discussions on the fiscal 1964 military space budget. NASA asked for \$6.2 billion but the bureau is understood to have cut this back to \$5.5 billion.

Of some assistance in coming to some space-related congressmen, NASA Administrator James E. Webb's reluctance to ask for additional money for the current space budget. Following White House instructions, Webb said the space program could be maintained without a supplemental appropriation. The fact is that the Gemini and Apollo manned space programs have been slowed by money shortages (AW Nov. 26, p. 26). Some members of the House space committee will urge NASA to ask for more fiscal 1967 funds in hearings early next year.

Leading candidate for the job as manager of the Spitz/Spang 50 man-hour space power project is Col. Edward M. Deschick, director of Group 1 and in the Army's Cambridge Research Laboratory. The manager will advise the Atomic Energy Commission and coordinate Defense Dept. and NASA activities through special deputies (AW Sept. 17, p. 31).

Last two major satellite launches of 1962 by NASA are scheduled next week—the RCA Relay active communications satellite on Dec. 14 and the SIVB noncommunications satellite on Dec. 12. Relay will go from Cape Canaveral, Fla., and SIVB from Wallops Island, Va.

—Washington Staff

ASSASSIN WIFE and BARE TECHNOLOGY December 5, 1948

Canada Selects HSS-2s for ASW Mission

By Donald E. Flak

Royal Canadian Navy has selected the Sikorsky HSS-2 two-turbine helicopter as its all-weather replacement aircraft for its Sikorsky HO4S-3 (S-35) anti-submarine helicopter fleet.

Decision to buy HSS-2s is the last step toward building a modern anti-submarine task force which will employ fast destroyer escorts, each equipped with a helicopter platform on the front. Canadian navy has ordered eight HSS-2s.

Selection of the Sikorsky aircraft was made after a thorough study of current helicopter by the Canadian navy. Kasco HSTK was given contract consultation (AW May 13, 1981, p. 33), but the mission profile and requirement that both detection and weapons systems be mounted on the same helicopter exceeded the HSTK's performance capabilities. Boeing Vertol's 107 also was considered, but its tandem rotor configuration made it too large for operations from the small destroyer escort.

First HSS-2 is scheduled for delivery to the Canadian navy by the middle of next May. Second and third aircraft will be delivered by the end of June, and the remainder at the rate of one per month for the next five months.

Initial order is expected to exceed 512 units, not including the 1,250 ship General Electric T-55-5 helicopter (caption, electronic submarine detection gear and weapons system).

First three helicopters will be off the shelf deliveries from United Aircraft Corp.'s Sikorsky plant in Stratford, Conn. The remaining five will be assembled in United Aircraft's Canadian Plant at Whitney (AW Jan 16, 1981, p. 32). These orders, however, will be modified.

Total scope of the program has not been determined, but a Sikorsky spokesman said follow-on orders are expected, with an increasing amount of the cruise training program being transferred to Canada. Apparently, the Canadian navy ASW fleet is envisioned at 70 helicopters.

Configuration of the Canadian HSS-2 will not differ appreciably from the U.S. Navy version (AW Jan 16, 1981, p. 32). These include, however, will be modified.

- **Automatic tail-folding device** to swing forward the rear portion of the tail rotor assembly. This is folded manually on the U.S. version.
- **Automatic tail-folding device** to swing forward the rear portion of the tail rotor assembly. This is folded manually on the U.S. version.
- **Winch-down device** which will permit operations from the small destroyer platform, measuring about 35 ft x 75 ft.

This equipment will not be ready for the first three deliveries, which will be rushed through to give the Canadian navy helicopter for a training program. Transition training for HO4S-3 pilots will be provided by Sikorsky instructors and U.S. Navy-trained Canadian instructors. U.S. Navy helicopter facilities probably also will be utilized.

While acquisition deliveries are made, the first three HSS-2s will be returned to Sikorsky for fitting of the

winch device and the winch gear. Canadian navy presently is operating its HO4S-3 anti-submarine fleet from the aircraft carrier HMCS Biscuit Bay. The decision to equip destroyer escorts with helicopter represents a modernization move to come with new submarine capabilities, and eventually will replace the current based operations.

Size of the helicopter-equipped fleet has not been definitively fixed, according to a Canadian spokesman, but this program will be reviewed in the fall of 1983 after trials with the first HSS-2s are completed.

At this time, the number of follow-on orders from Sikorsky probably will be determined by the maritime version of the HSS-2s, will be assigned to the Royal Canadian Navy training. The aircraft will be used in extensive sea trials with a platform equipped destroyer escort.

Operations from the small deck, which is not normally available will counter severe pitch problems, dictated by the inclusion of the automatic tail-folding device and the winch-down equipment.

Tail boom will need to allow down over the small barges which will adjust the landing deck. The auto make-folding device was chosen to eliminate hazards to shipboard personnel used to hold the boom manually.

Increased safety of the automatic system is expected to offset the additional maintenance problems it may cause.

Winch-down system, built by Thorne Industries Co., Ltd. Halifax, Nova Scotia, will serve both to pull the helicopter to a landing on the small deck and to secure it immediately upon touchdown. Landing will be taken or accomplished in three steps.

• **Helicopter pilot approaches the end of the ship's bow** about 40 to 50 ft above the deck, tail rotor over a light color line. A deck crewman attaches the winch-down cable to the line, which is pulled back up to the helicopter. It pulls a quick-attach probe into a housing in the bottom of the tail rotor, not forward of the nose door.

The helicopter is then slowly lowered pull-down by a winch below the deck.

• **Pilot maintains hover** power on the helicopter as deck is taken up in the cable. The helicopter is pulled down to about 18 to 22 ft above the deck. The winch has a slip-clutch which cuts even any shock caused by sudden updrafts as the helicopter and prevents airborne and cable stress.

- **Automatic lower capability.**
- **All-weather, dry-weather capability.**
- **Segmented sensor and integrated sensor system.**
- **High speed, rated at events of 350 mph.**
- **Rust hull.**

HSS-2 will operate with a two-man crew—two pilots and two sensor operators. Normal operational weight will be approximately 17,500 lb. Ultimately, helicopter-equipped destroyer escorts will seek to provide the ASW mission.



WINCH LANDING TECHNIQUE, which Canadian Navy will use to land HSS-2 anti-submarine helicopters on platform-equipped destroyer escorts, is tested near Sikorsky's Stratford, Conn., plant with HSS-2 in U.S. Navy markings. Helicopter pilot maintains hover power as the aircraft is lowered down by a cable attached to the bottom of the fuselage.



Super Frelon Undergoes Testing of Turbines

First photo of Sud Aviation's SA 3200 Super Frelon 26-tonner heavy helicopter shows the aircraft during initial turbine run-up tests which began the month. Machine is first of two prototypes. Super Frelon is powered by three Turbomeca T603 turbos (AW July 23, p. 46). Main rotor has 62-ft dia, foreleg is 75 ft 7 in. long. Gross weight is 17,514 lb, and cruising speed will be 115 kt.

quick release device which can be triggered by the pilot and a remote release which automatically disengages when turbine controls a specified limit. The second feature is used during takeoff to hold the helicopter on the deck until it has built up enough lift to leave clear.

- **As the helicopter is winched down** onto the deck, it must hold within a circle about 4 ft in diameter so that the cable, which runs down through a securing device in the deck, can pull the probe into it and lock it in place. This secures the helicopter to the deck.
- **Securing device slides in a slot** in the deck, anchoring the deck, now to push the helicopter into its longer without releasing the lock. Inside the fuselage, the lock can be released if maintenance requirements call for the helicopter to be moved or moved as pulled up. For most operations, however, the securing device will be left locked.

For takeoff, the helicopter is pushed back out to the middle of the deck. The securing device holds it down until it has the auto make-folding device the tension setting. The probe then pulls out and the helicopter lifts off. Tension setting in the probe housing can be used to allow for different weather and launch conditions.

Canadian navy feels the HSS-2 is slightly larger than desirable but it is the smallest helicopter that could meet the requirements. HSS-2 features which helped earn the decision in its favor included:

- **Automatic lower capability.**
- **All-weather, dry-weather capability.**
- **Segmented sensor and integrated sensor system.**
- **High speed, rated at events of 350 mph.**
- **Rust hull.**

HSS-2 will operate with a two-man crew—two pilots and two sensor operators. Normal operational weight will be approximately 17,500 lb. Ultimately, helicopter-equipped destroyer escorts will seek to provide the ASW mission.

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Telstar Is Silenced By Circuit Problem

Washington—Malfunction in Telstar command circuit, preventing ground stations from tuning its transmitter-receiver on orbit, has made the communication satellite incapable, at least temporarily, of its first job: to have months of nonstop operation.

Initially, the first evidence of the malfunction occurred less than a week after a Bell Telephone Laboratories component, which was held to repair the reliability effect which had enabled Telstar to achieve a record operational lifetime for satellites of comparable complexity (see p. 95).

The smaller Telstar's transmitter is still functioning and reporting data on internal operating conditions and Van Allen radiation levels. When first signs of trouble were discovered, a 1,200 orbit-it was decided to have the laboratory transmitter on permanently, since it draws only very small power, instead of running it off when the satellite is not within range of a ground station.

Two months ago, a major malfunction occurred in the command circuit, that did not affect performance of the Telstar's communication service, but which was a foreboding to the cause. The satellite was outfitted with dual command receivers, either of which

could perform the necessary on-off functions, with provisions for a ground station to shut down one command channel and check whether the other was still operating.

The order malfunction made it impossible at times to shut down one command channel. Van Allen radiation produced by the U.S. high-altitude satellite test July 9 has not significantly affected Telstar solar cells because they are radiation resistant. Non-F types with applied shielding, but there is speculation that the reinforced solar cells may have damaged semiconductor detectors on the command receiver.

At the time of failure, the command receiver that remains occupied continuously throughout the orbit had accumulated a total operating time of about 1,180 hr. The communications transmitter-receiver which remains operable to the is known, had achieved a total operating time of about 165 hr, according to Bell Telephone Laboratories.

DOD Designations On Pocket-Size Card

New service designations put forth by the Defense Dept. together with the previous designations, have been incorporated into Aviation Week & Space Technology on a listing card.

Placed, the card fits easily into a pocket, open it can be placed in a desk top. The card is available from Aviation Week at 25 cents each for 120 copies 30 min each for quantities of 250 and 10 cents each in quantities over 50. Send orders to:

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Examiner's Rebuff Shakes Merger Hopes

Decision is the fourth setback for American-Eastern union; final rejection by CAB or White House seen.

By Robert H. Cook

Washington—Reaction of the proposed American-Eastern merger by a Civil Aeronautics Board examiner last week was the fourth consecutive setback for the plan and increased the airline industry's feeling that the combination ultimately will be rejected by the Board or the White House, which must rule on the final decision.

Details of Examiner Ralph Wiser's decision follow closely and enlarge upon objections raised earlier by a House aviation subcommittee staff study (AW Aug. 2, p. 26), the Justice Dept. (AW Aug. 6, p. 45) and attorneys for the Board's Bureau of Economic Regulations.

The professional study rejected the merger on grounds that it would create a monopoly, "super carrier," leaving the airline industry under the "domination of a few giants." American-Eastern, United and Trans World Airlines, Dept. also emphasized the monopoly aspect and several that approval would run counter to the desired course of competition "set forth in President Kennedy's transportation message (AW Apr. 9, p. 42).

But notes emphasized on Wiser's report contained in a 75-page decision

and 246-page appendix, followed this general pattern:

- Merger would give the combined unit control over much of all domestic traffic and access to 75-80% of all domestic passengers. Along with United, the two airlines would control 60% of all domestic traffic.

- Monopoly would be created in the New England area, jeopardizing the customer of Northeast Airlines. Control would be particularly effective over the present Boston, New York, Washington

routes and those connecting New York with Providence, Chicago, Indianapolis, Hartford, Baltimore and Los Angeles.

- American-Eastern would gain a significant transportation route in direct competition with Delta and National airlines.

- Merged airline would divert far more traffic from existing competition than their existing airline.

- Operational savings claimed by the two carriers through a merger are small, and much could be accomplished without a merger.

- Financial strength and past operating history of neither American nor Eastern airlines justify the merger against all the bad factors on the grounds of business need.

- Release of the industry feels that it is "pinned through the neck" by its financial problems, caused primarily by the jet recap program, and that before traffic growth will arise among airlines.

Both American and Eastern stated that they are confident the merger will still be approved despite these objections. The case now goes before the five-member CAB, which is expected to file its final decision in early December.

case of Eastern's routes, says Mexican and American, and American's route into Mexico, the Board's final decision will be subject to White House approval.

Considering the failure of the merger applicants to win support in any major decision-making body, and CAB's duty to guarantee effective competition in the industry, most informed observers believe the final case will be based to reject the merger at this time.

- United-Capital merger with approval is expected to save the jobs of some 7,000 Capital employees who faced dismissal from a bankruptcy reorganization. It did not set in stone, however, precedent for a carrier getting between two carriers with the strength of American and Eastern.

- Board Chairman Alan S. Boyd's path to disavowment of more mergers is not shared by all members. Boyd once indicated that CAB would establish "carrier guidelines," but failed to do so.

On several occasions he emphasized a preference for mergers between major and one small carrier or two small carriers, but has never stated his opinion on any merger applicant involving two of the "big four" airlines.

- Approval of the merger would be contrary to the Board's continuous ethical and pro-union economic pro-unionism in strengthening airlines to compete better with the larger.

- CAB has taken great care to protect Northeast through such actions as approving financial aid and seeking to

Highly Test Case. Competition from an American-Eastern coalition would prevent the smaller airline from regaining financial stability.

- Neither American nor Eastern were successful in winning a settlement from contractual route between Florida and California. Connections of existing routes operated by these airlines is that such would give them such a route, dividing the available traffic among three airlines and thereby reducing the power of both Delta and National airlines. The latter has been showing a healthy profit along southern transcontinental route.

If the Board agrees Wiser's stand and opposes the merger, it will set the stage for a revolution to what extent the Justice Dept. objection reflect those of Attorney General Robert Kennedy.

It will also reveal whether these views are shared by his brother, the President.

President's Statement

The President has stated that "airline competition and efficiency can eventually be guided in the airline industry by vigorous competition and innovation," providing that Congress is "alert for any violations of existing laws against monopoly and predatory trade practices."

Separating the President's stand, Justice Dept. has warned CAB that "little will be accomplished in the public interest if the field remains unregulated by the President in dealing with the transportation problems of the

greater freedom and demand of regulation that the President envisages are to be achieved by only a handful of strong transport companies."

Wiser's decision reflected this own view in his statement that the merger should be denied because of its effect on the public.

Noting that the merger would "seriously damage" the competitive balance among the airlines, Wiser said, "It would be a long time before a true or fair carrier situation. And when that came about, many of the more carriers now in operation of duplicate facilities as presented here would be available to clear savings to partly offset monopoly."

Merger Impact

As an example of the impact of the merger on top markets, the examiner pointed out that American and Eastern carried 70% of the 1959 traffic on the top ranking market of Boston-New York. In the same year they accounted for 67% of the passenger volume between New York and Washington. Since then Eastern's traffic volume has been expanded and Northeast's participation in the market decreased 9.7% during the four quarters of this year. In the 11 leading markets on the Northeast, the two airlines carried 70% of the passengers, and in half of them, as noted from 87% to 97% of the total, he said.

The volume of traffic that the merger partners estimate they would divert



First Boeing 727 Transport Rolls Out at Renton Plant

First Boeing 727 three-engine transport was rolled out of the company's Renton, Wash., plant last week in the final of a 30-day program, finally designed to fit every airline need from short to long-haul service. Being less than 150 miles from the Boeing Co. plant, all of them have been ordered—Boeing is to be the first to build the first, last, and second market and Boeing officials admit some doubt as to whether to not the airlines will ever be sold in substantial numbers to build some operators. But they do



feature a market of 1,000 airplanes of the 727 type and hope to build between 550 and 650 units to build and interest in it. Evaluation of the airplane, which is powered by Pratt & Whitney JT8D engines producing 24,000 lb. thrust, is scheduled to reach three months by the end of 1965, and continue to a final form of eight months thereafter. Aircraft will carry 79-114 passengers, depending on interior configuration, over stage lengths of 190-2,000 mi. United Air Lines has ordered 40 of the planes,

Eastern 36, Aeroflot 15, Trans-Canada 12, Lufthansa 12, Austrian 15 and TWA 10. Cruise speed of the aircraft is 510-600 mph, and cruising altitude 15,000-17,000 ft. Wingspan is 30 ft. 7 in., length is 134 ft. 1 in., and height is 31 ft. 9 in. Landing weight is 115,000 lb. Passengers will enter and leave the aircraft by way of a side door forward and a ventral door at the rear. Single galleys midway in the cabin will provide for all passengers and will increase cost capacity.



3-D DYNASOAR mockup shown at Boeing's Seattle plant. Combining speed of ballistic missile in space with airplane-like control in atmosphere, U. S. Air Force's Dyna Soar will rocket into space atop giant booster, and orbit earth at speeds above

17,000 mph. Dyna Soar's pilot will be able to fly, glide back into atmosphere and land at will of his choice. Boeing is Dyna Soar system contractor, responsible for manufacture of glider, integration of vehicle and booster, and assembly and test.

Capability has many faces at Boeing



U. S. NAVY'S first isolated pistol unit, shown at Boeing. Shoring to prime conductors. Hydraulic, 115 lbs. bag, will fly on under water wings at speeds of 40 to 50 knots.

SPACE TWIST. Tests done by Boeing conclude optimum how much twist an astronaut, working weightless capsule orbiting earth, could carry in a month. Astronauts measure the efficiency of living techniques.



DASH. U. S. Navy's powered auxiliary helicopter, DASH, will be operated by remote control from destroyers. Powered by 300 hp Boeing T50 gas turbine engine, DASH is designed and built by Gyroplane Company of Anacapa. Boeing gas turbine can used in a wide variety of land, sea and air applications.

BOEING



Japanese Airport Program Enlarged; Honolulu Terminal Is Being Expanded

In addition to expansion of Tokyo International Airport (above) the Japanese Civil Aeronautics Bureau last week announced plans for a second Tokyo International Airport, about 40 miles to the south. The present facility at Haneda Express airport will have five runways and is expected to be capable of handling four times as much traffic as Honolulu. Cost of the new airport is calculated at \$101 million and would be operating in 1971. Ministry already has voted for \$45,000 to be allocated against 1969 in order to find a suitable site. There is some speculation that parts of Tokyo Bay may be filled in to accommodate the new airport. Plan is to have two of the five runways with 13,000 ft long completed in 1973. Construction on other three shorter runways will commence in 1975.

Honolulu Airport's new John Rogers Terminal (right) features a T-shaped boarding bridge and a few lines longer than the old facilities at the airport. Two United DC-8s are seen in foreground, two Pan American Boeing 707s are in the background.

EXPANSION PROGRAM at Tokyo International Airport (above) calls for newer structures, including the entire portion of Runway 6-22 now completed (1), and construction of a new 16,500 ft runway (2) paralleling the existing 9,200 ft, north-south-southwest runway, which also is being extended at the southeast end. A 10-story control tower is being erected (3), and expansion of the main terminal building is under way (4). A flight lounge and additional cargo space will be provided (5) and so will an enlarged parking area (6). A new expressway to Tokyo will provide a high speed link to the city. Terminal building enlargement will cost \$6-million and will double the building's available floor space. In addition to Tokyo's just underway, a contract is about to be granted for a terminal service to further speed traffic to and from downtown.





..... NEWS OF DEFENSE TECHNOLOGIES

RADAR

Sweeping advances in aerospace technology have caused radar targets to vary widely in size, range and altitude, speed and acceleration. Handling radar design problems are further intensified by electronic jamming and the need for decoy discrimination, creating a continuous demand for increased capabilities.

General Electric has anticipated this challenge with steady improvements in transmitter and receiver performance, mechanical design, and signal processing. Low-noise parametric amplifiers and receivers extend effective range while new pulse compression techniques improve target range discrimination. Antenna structures are built to increasingly closer tolerances for reduced side-lobes and precise angular positioning. Coherent integration provides both velocity resolution and high signal-to-noise ratios, combining with side-lobe nullers to diminish the effect of radar interference.

Such developments are reflected in a broad range of radars produced by General Electric and installed in virtually every major country in the Free World—radars that include the F7C-84 surveillance radar for the Air Force's BMEWS, the High Power Acquisition Radar (HIPAR) for the Army's Improved Nike-Hercules System, and the Marine Corps' high-mobility T1Q-84.



PHASED PLASMA ARRAY forms multiple scanning radar beams. GE's new arrays, more efficient in that they require the less of time each second to generate at least as many independently directed energy beams as needed.



GROUND-BASED F7C-84 search radar is one of the largest and most mobile radars. In the Soviet Advanced Ground Environment (AGEC) air defense system designed for the U.S. Air Force, it will detect supersonic high altitude aircraft at long range.



SPINNING ANTENNA for the U.S. Navy's SP-40 shipboard radar is contained in rail and pin-joint a unique dual ball screw drive. The precision, electric-driven design gives superior search and target tracking capability.



OPTICAL PROCESSOR uses all the energy to analyze high-resolution radar returns to find their true position and direction, not by conventional circuitry. This processing is done in the central of the radar system to determine range, velocity, and acceleration for multiple targets.



AWARDING F7C-84 will offer increased detection capabilities for fast early warning as well as discrimination in the control of intercept aircraft. This advanced radar is currently under flight test aboard the U.S. Navy's George Easton-class ship.

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SYSTEMS PROGRESS



CHECKING THE POLARIS MISSILE

Designed to process data from 180 channels at one time, a CSC system is now in use at the Sunnyvale, California, thermostructural test facilities of the Lockheed Missiles & Space Division.

Measurements of stress and temperature, recorded at hundreds of points on a Polaris missile being tested, are changed to proportional analog voltages by transducers and processed by the system for digital recording on magnetic tape complete for direct entry into an IBM 709C computer. In addition to temperature recording, output is available in the form of 4000 parameter words and 2.5 V plots. Monitoring is by live graphs on a 17 inch oscilloscope and oscillograph recordings.

This Thermostructure Rerecting and Monitoring System is one of hardware produced by CSC for data acquisition, recording, conversion, transmission and analysis. In addition to analog and digital data handling systems, CSC designs, develops and manufactures systems for structural control, electro-optical, pneumatic and hydraulic applications.

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Collision With Swan May Have Caused United Viscount Crash

Investigators speculated last week that collision with a small plane may have caused the Nov. 21 crash of a United Air Lines Viscount 70 at northwest of Baltimore, killing the 17 persons aboard.

Remains of a winging swan, a light flying bird that weighs up to 14 lb, were found lodged in the left horizontal stabilizer of the aircraft. Swallow divergence was disclosed on the right stabilizer, leading Civil Aeronautics Board investigators to theorize that one or more birds struck the tail assembly.

Loss of control could have come from either damage to the control system, or an aerodynamic flutter that broke up the tail surfaces, investigators feel.

Flight was in route from Newark, N. J., to Albany, Ga., with a scheduled stop at Washington. The pilot received edged pushman instructions from Washington approach controller, including a warning that other pilots had reported birds flying in the area at altitudes up to 6,000 ft.

Controller controller instructions directing a course change were not answered. Witnesses told of seeing the aircraft dive to earth at a steep angle. There was no evidence of an in-flight explosion, investigators said.

Aircraft's flight recorder was recovered and was being examined by the Bureau of Standards, seeking speed, altitude, heading and gravitational forces up to account of ground impact.

Accident was the fourth in less than a week's time involving commercial transports, others occurring in Peru, Brazil and France.

Vang Airlines Boeing 707 crashed near Lima, Peru, Tuesday while en route from Porto Alegre, Brazil, to Los Angeles, with stops at Lima, Bogota, Panama and Mexico City. Sixteen persons aboard died.

Flight had crossed the Andes and made its last report in the Lima town while at 12,000 ft, a short time before its scheduled 5:30 a.m. arrival. Early reports and the pilot also reported: "There is an emergency!" However, Vang of Lima said later in New York that no report station was made, and the emergency station was delayed at the airport after the plane did not arrive and radio calls were unanswered.

Discredited aircraft was found on a bare hilltop 2,400-ft high and 15 mi north of Lima. Weather conditions at the impact were 1,900 ft ceiling and light rain visibility.

Weather was scattered over a 200 sq mi area. Vang spokesman said the flight recorder, located in a main gear wheel well, had not yet been recovered.

on the day after the crash. Only a portion of vertical stabilizer was intact.

Civil Aeronautics Board test Charles F. Coffey, chief of the Southwestern CAB Region headquartered at Miami, to the scene, CAB instant steering from the aircraft being back to a U.S. fleet. Representatives of the Boeing Co. were standing in the investigation.

Another South American crash occurred Monday when a VASP four-engine jetliner collided with a light plane over Sao Paulo state in Brazil, killing 25 persons.

In France, a Malec Magister airplane II crashed Nov. 23 while making an instrument approach into Orly airport, Paris. Crashing was roughly 120 ft above the runway. The pilot of the Renault-built four-engine turboprop aircraft reportedly radioed, while on final approach, that he had doubts about landing conditions.

Civil radio frequencies warned the pilot that he was too low on approach, and the aircraft blew downgraded from the radio tower three minutes later. Aircraft struck the ground five miles from the runway, killing 21 persons aboard. French President Henri de la Motte-Rouge said the investigation is continuing.

Supersonic Transport Decision Is Due Soon

Washington — Federal Aviation Agency will submit its recommendations for a supersonic transport development program to the White House by the end of this month.

Administrator N. E. Habbema said that a few decisions on the Acute Mach number has not been made, but that he has development of a test and the area coordination, aircraft for an aircraft capable of flying at 3,000 mph.

Habbema indicated he was recommending a Mach 1 aircraft instead of a Mach 2 design now being worked out by the British and French (see p. 48) in his recent statement that "we may not be the first, but we want to have the best." He estimated it will take at least 10 years to build the supersonic transport.

FAA has already spent \$15 million on supersonic transport research, and Habbema estimates development costs will exceed \$700 million before the first model can be built at an expected price of \$4.5 million. He added that he will probably recommend that Congress appropriate the full development cost since U.S. has withdrawn civilian transportation projects such as U.S. United States and South Korea \$500 million.

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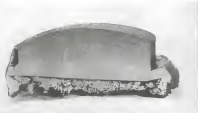


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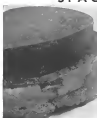
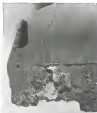
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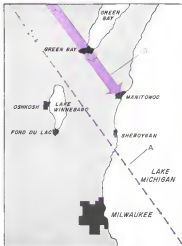




SECTIONED FRAGMENT of Sputnik 4 satellite shows shape of ablated steel on underside (left), embedded nut and flanged bolt (right)



EDGE OF STEEL PLATE contains counter-layered bolt hole (left). Full view of fragment (right) indicates disk-like configuration



PATH A SHOWS observed track and formation of the six fragments tracked by Milwaukee observer. Path B indicates possible track of fragments recovered in Manitowish.

U. S. Analysis

By Warren C. Wetmore

Cambridge, Mass. — Metallurgical studies of fragments from the Soviet Sputnik 4 satellite, which fell in Wisconsin, Wis., Sept. 6 revealed that they were composed of a powdered, metal-iron-carbon steel, according to officials at the Smithsonian Astrophysical Observatory here.

Sputnik 4—and by the Soviet Union to be a test of the Rurik-10 report since later incorporated into the named Vostok, spacecraft—was launched on May 15, 1968, and designated 1960 Epilone (AW May 23, 1960 P. 77).

Satellite, according to Soviet reports, carried a dummy component in a pressure vessel. It was prepared for a controlled reentry.

When the control system failed and the astronaut died in the wrong direction, the spacecraft was heated into a higher orbit (AW May 30, 1960 p. 16). Following that error, the vehicle disintegrated into several pieces, the largest of which thought to be the object was designated 1960 Epilone 1 (AW June 6, 1960 p. 30) and associated with a dark atmosphere on Sept. 5.

Recovered objects include heavily ablated cast-iron splinter resembling debris meteorites, with diameters ranging from 1 to 2 in. and a disk-shaped object with a diameter of 7.9 in. and a thickness of 1.2 in. The latter which weighed 18.4 lb. before a surface was removed for analysis, has two distinct parts (see photos)—a dark, solid end and a lighter, flange-like end. The latter part has a diameter of 4.9 in. and a regular plate 0.70 in. thick.

The two are welded together around

Reveals Sputnik 4 Fabrication Techniques

the perimeter of the cylinder except for a 10 deg. arc. The plate appears to have been machined to a depth of approximately 1/8 in. to accommodate the nut, and the interface between the two is extremely smooth. A metallograph also examined the object at Massachusetts Institute of Technology around the world, very good.

Examined top surface of the cylinder and the plate show evidence of ablation, although the cylinder has retained its sharp upper perimeter. The ablation formed by the cylinder and plate is partially filled with embedded steel, the appearance of which suggests that it flowed from the top surface during reentry.

Irregular grain of ablated steel adheres to the underside of the plate and is banded and porous in appearance as might be expected from the solidification of molten steel. Composition of the part is identical to that of the unaltered portion of the disk, except for a decrease in the concentrations of some of the more volatile trace elements.

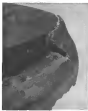
Overall appearance of the disk, leads evidence to the Smithsonian suggestion that it is a cylinder of the disk, except for a decrease in the concentrations of some of the more volatile trace elements.

While the disk was sectioned for scientific analysis, a hole was revealed on the bottom of the plate. The hole—one end of which is threaded into a flanged nut—has outer-diameter dimensions with 6 mm dia. and one threaded per millimeter.

The hole has not undergone analysis, as was suggested by an MIT metallograph, as it is there as a place to search for other objects that might be associated by the ablated steel.

As yet, no positive identification has been made of the precise function of the disk-shaped object in the satellite. Dr. Charles A. Lundquist, Smithsonian's senior metallurgist, said that it may have been a ballast or a part of the heat sink in the reentry shield, which would replace its normal appearance.

Smithsonian officials, including Mr. Alvin M. Moseley, head of the Rurik-10 program for monitoring satellite reentry, have been approached for an explanation of the disk, but to date none has been offered.



HEAD OF WELD from steel cylinder and plate. Note shape and texture of solidified steel which ablated from top of cylinder to 58 part of diameter

Proof that the object had been above the atmosphere for a considerable length of time and was not a dummy, was obtained by means of radiological tests conducted at Los Alamos Scientific Laboratory. A cadmium-109 isotope Auger 17 was detected in the test sample. This isotope was formed by bombardment with gamma rays and trapped particles in the Van Allen belts.

Test for tritium, a highly radioactive isotope, was negative, but this was attributed to the fact that the substance probably flowed away during reentry into the atmosphere.

Smithsonian officials accepted the unaltered appearance of even-sized observation of reentry, recovery of fragments and scientific investigation to a combination of luck and enthusiastic support by members of three Milwaukee teams field investigation personnel and scientific staff.

Monetary funds, which were organized in 1958 for the purpose of monitoring satellite reentry, were alerted throughout the world following production by the North American Air Defense Command's Space Detection and Tracking System (Spartan) that Sputnik 4 would re-enter the atmosphere on or about Sept. 6. Reentry cylinders computed by Milwaukee headquarters indicated that the satellite would pass near earth in the Milwaukee area during its first orbit at 4:58 a.m. local time.

Three trained observers on the Milwaukee team, equipped with theodolites, were waiting for the satellite. Two were stationed at the Milwaukee Observatory on the western side of the city, while a third was stationed 18 mi. away in downtown Milwaukee.

At 4:49 the downtown observer re-



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Real analysis of Telstar's telemetry data—received by Radiation designed and built command tracking antennas—indicates the cosmic pressure is still above 5 lb./sq. in., showing that the carrier has not been purchased; average temperature inside of 25°F, average sun temperature of 207°; solar cells delivering 0.6 amp at 125-W, and a radiation induced de-

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and an immediate strike-like object low in the northwest sky. The object appeared to separate into a number of pieces and by the time the first fragment 510 deg, altitude 8 deg above the horizon—was made, an separate piece glowing with an estimated temperature of 10,000 deg, were disintegrated moving rapidly southeast in a crescent pattern with the largest body leading the formation.

Largest Object

Largest object was at an azimuth of 9 deg (true north) and altitude of 12 deg at 4:41:47 local time as recorded by stopwatch and later compared with the National Bureau of Standards WWV radio time signal. At this time only the leading object was visible. It was tracked out over Lake Michigan to azimuth 16 deg, and altitude 11 deg, where it finally became invisible.

Two team members of the observation witnessed the event and corroborated the report of the downtown observer, although they were unable to observe (possible bias).

Several persons along the center path in northern Wisconsin observed the passage of the fragments, which ranged in number from five to more than 25 in the various accounts. While part of the discrepancy in the reported number of pieces can be attributed to confusion, it is likely that the smaller fragments disrupted their best view.

rapidly than the larger ones during the passage through the lower regions of the stratosphere, so that the visible number of meteoric fragments decreased along the re-entry path.

Many witnesses believed they had observed the disintegration of the solid line, but their accounts generally placed this event at a low elevation, which indicates that their observations probably were affected by parallax.

However, one Canadian reported that he saw the vehicle break up into several, which increases the likelihood that he witnessed the actual disintegration. These were several reports of a third object, none in the direction from which the fragments came after they had passed. This was probable due to the shock wave created by hypersonic reentry.

Impact in Street

Apparently the fragment had been decelerated to low subsonic velocity at the time of impact, for the impression it made in the street at the time of impact was only about three inches deep.

Two policemen patrolling the area at 5:10 a.m. noticed the fragment lying



Roving Device Could Photograph Moon Surface

Earth-Moon vehicle, designated "Rover," has been developed by General Dynamics/Telecommunications to carry four nuclear powered television photos and transmit other data from earth. Rover, which will be deployed from a gravity or air-launch freefall sled system that is powered by the sun. The vehicle would also analyze samples of the lunar surface and report its findings back to earth.

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to the middle of the road, but in the first rush morning light they mistook it for cardboard and ignored it. When they passed it again at 7 a.m. it appeared to be metal, and they stopped and moved it to the side of the road, after finding that it was too hot to handle except for brief periods at times.

The unexcited fragment removed at the edge of the road until the afternoon, when police, acting on reports that there might be pieces of a satellite in the vicinity of Manassas, returned the object and moved it to police headquarters.

From then, the object was taken to Milwaukee and flown to Cambridge for positive identification.

Additional Fragments

The search for additional fragments began several days later when a Smithsonian field representative arrived in Manassas. A small piece had been found in a tree about 112 ft from the impact point. Further search along the line defined in the main impact point and the point where the smaller fragment was found yielded 15 small objects on a road about 33 ft from the impact point and two small metallic clusters at a distance of about 500 ft from the main impact.

The largest body, now lacking the forewings of fragments by the Milwaukee Museum, obviously is presumed to have fallen into Lake Michigan, which is less than 7,000 ft from the impact point. Smithsonian officials



Satellite Spectrometer

Fast infrared satellite measurements of rock from satellite by photon data are made with working satellite sensors now made using this. It is an extremely large spectrometer by Air Force Cambridge Research Laboratories (AFRL) No. 18, p. 23. Instruments used by Rock Associates, now measurements can load of 15 to 16 m. errors in terms of measured exposure such covering diameter of about 50 m. at the only. Devco has instruments which is 10,000 times that of conventional spectrometers according to Rock Associates. AFRL, plus to use device to make similar measurements at the ultraviolet and visible part of spectrum from a satellite.

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PROBLEMATICAL RECREATIONS 147



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now the Navy must protect both targets against enemy subs

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AAF Minuteman environmental system gets

328 hour warm-up for a long and lonely life

Deeply buried in isolated launch sites, the Minuteman missiles will strike back instantly, even under direct attack. That is well known. But how can each missile, with its sensitive guidance elements, remain always operational and ready? Part of the answer is the Minuteman's environment support system—prime contractor, American Air Filter Company Defense Group. A system of heating, ventilating, air filtering, refrigeration, and humidity control may seem commonplace. Yet few firms even felt qualified to bid on this Minuteman component. The technical problems were staggering. The reliability of hundreds of missiles was at stake. Also the ability of remote control personnel to survive and reliable AAF's capability for such a task had evolved over four decades of power engineering and large-scale production for military and civilian industry. But even

Reliability facilities like this test each AAF Minuteman component

AAF engineers were surprised at the speed with which Minuteman's urgent schedule forced them beyond previous limits of the art of environmental control. Component after component was redesigned, as AAF moved inevitably away from the idea of engineering the weapon—to create a successfully integrated part of the weapons system itself. In completing its part of the system on schedule, AAF's Defense Group added its own production plants, plus resources of our Air Filter Division, Temper Air Group (Hormans Nelson), Fiber Glass Group (Arner glass), and other AAF divisions and subsidiaries. This corporate team offers scope, flexibility, and effective systems management capability. If environmental control is important to your project, and for AAF Ballston, D-360 Waste Defense Products Group, American Air Filter Company, Inc. 310 Third Street, Rock Island, Illinois.



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Moon Vehicle Power System Uses Hydrogen, Lithium

Auto's concept indicates key elements in new power system for moon vehicles designed by Martin Marietta's Space Systems Division, Baltimore, Md. Hydrogen gas, produced by heating liquid hydrogen, drives turbine/generator to break electrical power for various systems. Hydrogen flow would be controlled into fuel cell to produce additional electricity for vehicle. Hydrogen combined with lithium in cell to produce lithium hydride for storage aboard the vehicle. Nuclear reactor providing station could break down lithium hydride into components and pump them for use by the vehicle.

and that the Navy is considering the use of driven jet aircraft and manned operations.

An attempt was made to return the fragment to the Soviet Union during a session of the United Nations Committee on Peaceful Uses of Outer Space on Sept. 14. P. D. Maslennikov, the Soviet delegate to the committee, refused to accept the object for his government, and labeled the move "a gross trick" intended to strengthen the U. S. position on the committee, which was waiting on rules for liability for injury or damage resulting from objects re-entering from orbit.

To date the Soviets have neither confirmed nor denied that the fragments were part of a Soviet satellite. Southwestern officials said, and the incident involved no coverage in the Soviet press.

However, it is likely that members of the Soviet scientific community are aware of it.

In addition to these national, regional and institutional goals have emerged. For fragments include the National Aeronautics and Space Administration, Brookhaven National Laboratory, the Air Force Cambridge Research Laboratories, Department of Chemistry at the Carnegie Institute of Technology, and the Central Intelligence Agency.

The final disposition of the disk-shaped fragment is undetermined at the present time, Southwestern officials said, although the Soviets may claim it any time. Scientific investigations



Density Sensor

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By James Sullivan

Arbitr. Trent heard them close quietly. The lenses, stary words shot out of his memories.

"There? You can't get away. We will intercept your orbit in two hours and if you try to resist we will blow you out of space."

Trent smiled and said nothing. He had no weapons and no need to fight. In fact less than two hours the ship would make its jump through hyperspace and they would never find him. He would have with him nearly a telegraph of Krellman, enough for the construction of the trinket-pieces of thousands of robots and worth some ten million credits on any world in the Galaxy—and no questions asked.

Old Broommeyer had planned the whole thing. He had planned it for thirty years and more. It had been his life's work.

"It's the pitiful, young man," he had said. "That's why I need you. You can't sit a ship off its ground and not fire faster I can't."

"Getting a ship space is no point, Mr. Broommeyer." Trent said, "it will be caught in half a day."

"No," said Broommeyer, calmly, "I will make the jump, not if we flash through hyperspace and not in light years away."

"It would take half a day to plot the jump and even if we could take the time, the police would alert all stellar systems."

"No, Trent, no!" The old man's hand fell on his clenching as it trembled excitement. "Not all stellar systems, only the dozen in our neighborhood. The Galaxy is big and the colonies of the last fifty years and years have lost touch with each other."

He talked steadily, passing the pattern. The Galaxy was like the surface of music original planet. Here they had ruled it in primitive times. Men had been scattered over all the continents but each group had known only its own community surrounding itself.

"If we make the jump at random,"



Broommeyer said, "You would be anywhere, even fifty thousand light years away, and there would be no most chance of finding us than of finding a pirate in a major sector."

Trent shook his head. "And we don't find ourselves, either. We wouldn't have the proper way of getting to an unknown planet."

Broommeyer's quick smiling eyes inspected the surroundings. No one was near him, but his voice sank to a whisper anyway. "The space thirty years before this, on every habitable planet in the Galaxy I've searched all the old records I've saved for thousands of light years, farther than any spaceship. And the location of every habitable planet is now in the memory zone of the best computer in the world."

Trent lifted his eyebrows patiently. Broommeyer said, "I mean computer and I have the lens."

"We also plotted the exact location of every human star in the Galaxy, every star of central class F, K, A, and G, and put that into the memory zone. Our work made the jump the computer will catch the lenses systematically and compare the results with the map at the Galaxy it contains. Once it finds the proper match and once at last it will, the ship is located in space and it is then automatically guided through a narrow lane to the neighborhood of the second inhabited planet."

"Simple, too complicated?"

"It isn't that. All these years I've worked on it and it can't miss. It'll have ten years left to be a millionaire. But your people, you'll be a millionaire much longer."

"When you jump at random, you can't find a star?"

"You see chance is a brutal thing. Trent, we might also land so far from any human star that the computer can't find anything to mark up against its program. We might find we've jumped only a light year or two and the police are still on our tail. The chances of that are smaller still. If you want to worry, worry that you might die of a heart attack at the moment of take-off. The chances for that are much higher."

"The night, Mr. Broommeyer. You're alone!"

"The old man shrugged. "I don't care. The computer will do everything automatically."

Trent nodded and remembered that one evening, when the ship was ready and Broommeyer arrived with the Krellman in a briefcase the last no difficulty for him was a greatly created man. Trent took the briefcase with one hand while his other moved quickly and surely.

A knife was in the box, but as quick as a modernizer's equipment, just as fast and much more quiet. Trent left the knife deep with the body, beside the telephone. What was the difference? They wouldn't go far.

Deep in space now, with the police-captain in pursuit, he felt the pulsing traces that always preceded a jump. No policeman could explain it, but every space-warrior knew what it felt like.

There was a momentary point-of-first-possible ship and himself, for one moment of non-space and non-time, because non-matter and non-energy, then resounded dimensions and continuously in another part of the Galaxy.

Trent smiled. He was still alive. No star was too close and there were thousands that would glow around him. The sky was clear and stars and the pattern was so different that he knew the jump had gone for him. Some of those stars had to be spotted when it came. The computer would have a new rich pattern to match against its memory. It shouldn't take long.

He looked back at comfort and watched the lens point at the light, more in the light moved slowly. A bright star came into view, a really bright one. It didn't seem more than a couple of light-years away and his pilot's voice told him it was a low one—good and hot. The next pattern would use that as its base and match the pattern centered about it. Once again, he thought, it would be done.

But it did. The minutes passed. Then at last. And still the computer clicked softly and its light flashed.

Trent frowned. Why didn't it find the pattern? The pattern had to be there. Broommeyer had showed him his last years of work. He couldn't have lost a star or recorded it in the wrong place.

Suddenly stars were born and died and moved through space while in being, but these things were slow, slow like a million years. The pattern had Broommeyer had recorded couldn't—

A sudden point crashed at Trent. "It's broken!" he said. "The chance for it was even smaller than jumping into a star's interior."

He moved for the light star in one instant and the ship was in the light. He brought a new situation. That was just to all the magnificence he could, and around the bright crash of light was the outline of a star. The star was as bright as it was, as bright as it was, as bright as it was.

It was a new star.

From dim obscurity, the star had moved itself so bright. The ship was in the light. It had moved from a central dim glow enough to be ignored by the computer as so small. The ship was not commonly taken into account.

But the stars that moved in space didn't exist in the computer's memory zone because Broommeyer had not put it there.

It had not moved when Broommeyer was following his dream at least not in a human way.

"That's great!" choked Trent. "I'm not!"

But he was shouting at automatic machinery that would match the same central pattern as the Galaxy pattern and find it anywhere and anytime, nevertheless, to match and match and search for as long as its energy supply held on.

The ship would not rest much longer. Trent's life would rise away much more.

Suddenly, Trent stopped in his sleep, watching the motion pattern of one light and beginning the light and spaced out for days.

— If he had only kept the lens

HOW SCIENCE FICTION BECOMES SCIENTIFIC FACT

Matching the fact of Trent's earlier prediction, computer would be easy, just that a lot of the sort of thing we are talking about would have to be done.

The power levels of ordinary household, for example, is among our specialties—though our computers now do it in tremendous numbers, hundreds of electric units.

Early, we completed a multi-million-dollar job as project contractor on a major communications system. This involved building an eight-company team, including people at Cornell, Stanford and Lockheed, to coordinate delivery of the program. It's less our design privilege to develop advanced communications systems for all three branches of the Armed Forces.

New war systems in this field have turned their backs toward similar systems in space, developing new ways to play hide-and-seek with adversary satellites and command spacecraft.

No less spectacular than the completion of "Starlight" when viewed in current accomplishment, is the performance of Hoffman's team at guiding an Air Force B-54 on its round-trip, 11,000-3 mph overnight mission around the globe at altitudes to 50,000 ft. That, one of the more than 200,000 such airborne missions we've made in recent years, is required for various missions in the process of keeping this hyperintensive system on course toward its goal.

With Hoffman's team on one side, my own military search—from behind us through the lines March 3 bombers—on the other, we have been working on pinpoint accuracy. Bearing and distance information provides means for us to control the mission.

Less down to earth, the needs of our men at Hoffman's team. With us is a full-oncoming team. Berlin, they are. They are working toward a new way to play hide-and-seek with adversary satellites and command spacecraft. We are working on our computer's first step in the process, as well as developing some communications systems that will be these home: return back, as its electronic focus on the power. And program is being made in both areas, and we have every hope of broadening our contributions to the space program for beyond what we've been moved to provide so far.

Our business, you see, is something science fiction is specific. It's the science of the future, and we know that about. These broad areas of military electronics communications, navigation, reconnaissance, surveillance, and defense are all areas of military energy into electric power. If you have a problem that might relate to what we do, let us know.

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Space Docking Simulated by Boeing

Swedish photon exploration vehicle, left, is being guided by pilot to mockup of with space ship in experiment staged out at the Boeing factory in Seattle. Pilot's controls are connected through an audio frequency to an overhead crane which carries the space ship. Space ship's movements, made in response to pilot's control movements, simulate movement of the ship's vehicle. The pilot's vehicle naturally is confined. Pilot can control pitch, roll and yaw of his vehicle, according to Boeing.

NASA Soft-Lands Mercury Bollerplate

Bollerplate Motors' capsule has been successfully landed at Glen Rose Air Field, near San Marcos, Tex., in demonstration of a soft landing technique being studied by National Aeronautics and Space Administration's Manned Spaceflight Center for future Manned Space Vehicles.

System under study utilizes a 65 ft. dia. rigidly pivoted modified by the addition of a flap that permits steering

the chute in desired directions and also turning the glide angle.

The Mercury bollerplate also was fitted with a landing attachment, providing 7.12 degrees of approx. earthward aimed.

In the last of a series of four recent tests—previous three involved in the landing—the capsule was dropped from a UH-1H Pavebird CH-119 hoisted in 1,000 ft. over the air field.

In the four drops conducted, various impact accelerations ranged from 7.7g to 18 kg and impact velocity has attained a maximum speed of 7 ft/s.

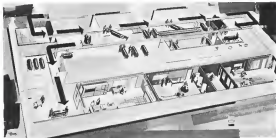


Dyna-Soar Landing Gear Tested

Dyna-Soar (X-20) landing gear is tested on a 1,800 lb. rocket sled mounted on a 55,000-lb. support vehicle test track at Holloman Air Force Base, N. M. Sled is powered by solid propellant launchers totaling 77,000 lb thrust. Landing gear is subjected for a total of 10 runs simulating several different types of landings.

WORLD'S FIRST...

Rocket Motor Assembly Line



Production of Operational Cases Virtually Unlimited

New filament winding facilities developed by BSB allow assembly line production rates and efficiency, yet maintain exacting tolerances and rigid quality control.

BSB filament winding machines basically consist of hydraulic servo operated chamber rotation and glass resin supply systems. A pre-set programming controller establishes the geometry of the chamber windings. This system maintains exacting tolerances and assures repeatability and reliability. Assembly areas are dust-free. Temperatures and humidity are rigidly controlled. Detailed standard instructions assure quality which will meet the most exacting requirements.

The assembly line is carefully monitored by highly trained quality control personnel, ensuring compliance to specification in every phase

of the operation. The area represents a great *offshore* potential because production capacity can be doubled or tripled in a relatively short time. Operational Rocket motor cases that have been produced in quantity by BSB include Third Stage Minuteman, Second Stage Polaris A2, Altair A5 and A6, First Stage Polaris A3, Second Stage Polaris A3, and the First Stage Minuteman.

Applying modern production methods is not new at BSB. Over the years the company has successfully developed and applied modern manufacturing techniques for such diversified lines of products as oil and gas processing equipment, control valves, automotive parts, automation systems and electronic instruments. Want more information? Write BSB, Industrial Air Park, Ardmore, Oklahoma.

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RCA NUVISTOR TUBES
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The astronaut's pulse and blood pressure vary with stresses of acceleration...his breathing becomes harder...his body temperature fluctuates a fraction of a degree.

Infinitesimal changes in the void of space...yet each minute variation is perceived, recorded and analyzed at a tracking station a thousand miles distant. Such is the wonder of satellite telemetry in the space age. A key component in these incredibly complex systems is a new electron tube from RCA—the NUVISTOR. Scarcely larger than a pencil eraser, this tiny giant has the ruggedness, stamina, dependability, high performance and resistance to radiation that space-age jobs demand.

Because of NUVISTOR's extreme sensitivity and fidelity of response, nuvistORIZED circuits can detect and amplify—without distortion—signals reflecting the smallest changes in physical

environment or condition...changes that might be lost or distorted by less sophisticated components.

RCA NUVISTORS—symbolizing today's trend of packing more and more electronic performance into less and less space—are at work in scientific marvels ranging from satellites and radiation counters to radar systems and home television sets. They are another product of RCA's unending effort to create new tubes for new uses—in home entertainment, in science, industry, medicine, and national defense.

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RCA Penial Tube
designed to
enable precise
control of electron
beam in such
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RCA Gamma Tube
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Noise Laboratory

New Research Laboratory opened by National Aeronautics and Space Administration at Langley Research Center, Va., consists of critical test cells with interior dimensions of approximately 27 ft. Cell is designed to study noise created by turbine or rocket engine turbine noise or compressor noise. Cell is equipped with a program linear capable of producing test pin with temperature rise up to 1,500° F. inside.

Combustion Chamber Shock Tests Begun

New York—Effects of combustion chamber shock waves, which result from water-air combustion in liquid fuel rocket motors and some thrust augurs, are being explored by a Polytropic Institute of Brooklyn research team.

Tests are being conducted at the Institute's Polyatomic, N. Y., Graduate Center and are funded by a 591,387 Air Force study grant. A 7-in. dia. 50 lb. thrust motor, fueled with JP-5A is used in the test rig.

Shock waves are introduced into the motor's combustion chamber with a small piston, which is actuated by a modified design firing chamber using shells with the shot removed.

Piston movement causes a contraction shock wave in the combustion chamber and creates microstream to determine which wave frequencies build up and cause motor malfunction and which ones damp out. Preliminary test results indicate that fuel droplets are condensed by the shock waves. These disrupt the gas dynamics and cause thrust sag.

ACTION MEMO
FROM: Production Manager

TO: J.M.H.

Dep't 31-4

Let's get these Cherry people in here and see if this Cherrylock rivet will solve our sheet gap problem. The blind rivet we are using now certainly doesn't

E.B.B.



- Positive Mechanically Locked Stem
- Flush Fracture (No Stem Hammering)
- Strong Clinch
- Wide Grip Range
- Positive Hole Fill

United States Patent Nos. 2,912,133; 2,912,134; 2,912,135; 2,912,136; 2,912,137; 2,912,138; 2,912,139; 2,912,140; 2,912,141; 2,912,142; 2,912,143; 2,912,144; 2,912,145; 2,912,146; 2,912,147; 2,912,148; 2,912,149; 2,912,150; 2,912,151; 2,912,152; 2,912,153; 2,912,154; 2,912,155; 2,912,156; 2,912,157; 2,912,158; 2,912,159; 2,912,160; 2,912,161; 2,912,162; 2,912,163; 2,912,164; 2,912,165; 2,912,166; 2,912,167; 2,912,168; 2,912,169; 2,912,170; 2,912,171; 2,912,172; 2,912,173; 2,912,174; 2,912,175; 2,912,176; 2,912,177; 2,912,178; 2,912,179; 2,912,180; 2,912,181; 2,912,182; 2,912,183; 2,912,184; 2,912,185; 2,912,186; 2,912,187; 2,912,188; 2,912,189; 2,912,190; 2,912,191; 2,912,192; 2,912,193; 2,912,194; 2,912,195; 2,912,196; 2,912,197; 2,912,198; 2,912,199; 2,912,200; 2,912,201; 2,912,202; 2,912,203; 2,912,204; 2,912,205; 2,912,206; 2,912,207; 2,912,208; 2,912,209; 2,912,210; 2,912,211; 2,912,212; 2,912,213; 2,912,214; 2,912,215; 2,912,216; 2,912,217; 2,912,218; 2,912,219; 2,912,220; 2,912,221; 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LEADING-EDGE CONTOUR GEOMETRY was used by Grumman for entry vehicle design.

Vehicle has been wind-tunnel tested.



GRUMMAN RELIEVES that blunt-body of the edge design concept very much as a useful tool in re-entry vehicle design.

Model Martian Atmosphere Constructed to

By C. M. Plotner

Philadelphia—Variety of analytical techniques for preliminary design of planetary entry vehicles, including independent estimate of future planetary exploration, was proposed here at a recent symposium on Dynamics of Manned Landing Entry co-sponsored by General Electric Co.'s Space Sciences Laboratory and Air Force Office of Scientific Research.

Typical of the preliminary design research tools was an engineering model atmosphere of Mars, presented by Gerald F. Schilling of The Rand Corp. It defines the upper and lower limits of pressure, temperature and density in the Martian atmosphere up to 150 km in the middle and low altitudes.

The limits established are independent of time of day or season.

The proposed model is characterized, however, by a broad spread of probable

values indicating the present scarcity of knowledge of the planet.

Deficiency of the engineering model atmosphere does not lie in the definition of absolute flight conditions reported but rather in the fact that actual conditions encountered can still be expected to fall within the limits indicated. It is representative of the state-of-the-art efforts to formulate precise entry aerodynamic design tools for building a Martian entry vehicle with few alternate guide lines to go by.

In the past, model Martian atmospheres have been constructed with methods giving limiting conditions for various atmospheric parameters. These are similar to one constructed for earth's atmosphere before the advent of sounding rockets and satellites. But the wide latitude of environmental conditions in which the various model Martian atmospheres were based make a choice of any one of these more

a matter of speculation than a scientifically sound decision.

The advantage of an engineering model Martian atmosphere is that the user is released of the requirement of making a particular choice of certain specific conditions most likely to prevail at the time of entry.

Construction of the engineering model atmosphere was based on the best known values for equatorial and polar values, planetary mass, solar constant, planetary radius and probable extremes of mean air temperature. Nitrogen was assumed to be the primary gas in the Martian atmosphere with possible some carbon dioxide, nitrogen dioxide, oxygen and ozone also present.

As a preliminary design tool, according to Schilling, the actual conditions of the Martian atmosphere can still be expected to fall within the limits given, permitting selection of suitable reference requirements into design studies.

Schilling noted that entry into the Martian atmosphere would probably be easier than entering the atmospheres of other Venus or earth based on Mars' relatively small planetary mass and gradual decrease of atmospheric density with altitude.

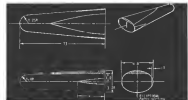
Comments that Mars would be the first planet to be explored rather than Venus (which in the planet closer to earth) was shared by many scientists at the symposium. Cloud cover on Venus has almost obscured to them only a small amount of basic information about the planet's atmosphere and surface.

Recent studies of successive indications received from Venus have indicated that possible for the first time we are receiving information on a planet

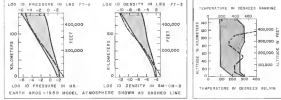
Aid Planetary Exploration Vehicle Design



GRUMMAN'S BLUNT-EDGE ENTRY configurations is tested at subsonic speeds (left) and supersonic speeds (right) to gain information on flow and shock characteristics at an angle of attack of 33 deg. Shock wave at right was produced at Mach 4 in low angle of attack during tests Grumman conducted at supersonic speeds.



AIR FORCE SCORTE vehicle is designed to explore aerodynamic, aerothermodynamic and performance characteristics in the velocity range of 5,000 to 1,600 ft. per sec. Vehicle is tested in the test ship beyond Apollo and Dynafire.



ENGINEERING MODEL OF MARTIAN ATMOSPHERE shows predicted pressure, density and temperature at various altitudes. Panel speed of profile values indicates scarcity of firm information about Martian atmosphere. Double model atmosphere of earth, composed of 10% as shown as dashed line. Martian atmosphere was based on the best known values for equatorial and polar values, planetary mass, solar constant, planetary radius, and mean air temperature extremes.



NUCLEAR POWER... GIANT STRIDE INTO SPACE

■ Nuclear propulsion is moving swiftly to the forefront of space exploration. For challenging solar and planetary missions or scientific investigations beyond the plane of the ecliptic, nuclear propulsion is essential. For lunar missions, it is highly attractive. This is substantiated by Dr. Glenn T. Seaborg, Chairman of the Atomic Energy Commission: "I believe that nuclear propulsion could provide the most feasible means of accomplishing space missions involving heavy payloads and long voyages in the foreseeable future."

As NASA's industrial partner in the management and accomplishment of the RIFT (Rocket-In-Flight Test) program, Lockheed is a leader in this dramatic application of nuclear power to space flight. Lockheed's role is the design, development, integration, application and testing of the first nuclear-propelled space vehicle. Its purpose: To demonstrate the feasibility of nuclear propulsion in a space flight environment.

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Pioneer-Central Division



mental conditions beneath the cloud cover. Analysis of the massive reflection index indicates temperatures as high as 700K to 715K compared with forecast assumptions of 150K to 400K. Contrary theories, however, that the microwave radiation observed might be scattered from high altitude in an atmosphere are not completely discounted.

There is little known about the Venusian cloud layer itself as there is about the surface at ocean. Peter P. Wagner, Yale University professor and Rand Corp. consultant noted in a summary of attempts to explain the existence of the Venusian cloud layer.

Venusian Clouds

Cloud composition theories attempting to reproduce Venus' suspected high surface temperatures include a non-diffuse, dust-laden troposphere with heat radiated by wind shear proposed by J. I. Oppé and a greenhouse model of the atmosphere with sea crust radiating up a thin dust layer proposed by C. Sagan.

Wagner told the symposium that with the partial insularity of knowledge of Venus there was not enough basic information to provide reasonable aerodynamic predictions for the Venusian atmosphere. Mariner 2 probe scheduled to pass by Venus Dec. 14, should yield considerable useful information during its microwave and infrared scan of the cloud-shielded planet.

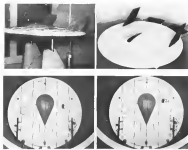
Characteristic results of attempts to calculate aerodynamic parameters for Mariner and Venusian atmospheres were presented by Wagner. The calculations which had been performed under a joint Air Force-Ford Program 1 laboratory contract resulted in discrepancies up to several orders of magnitude from order of magnitude as defined in a factor of 10, two orders, 100 etc.) Discrepancies resulted from uncertainty of free molecular flow conditions and density.

The aerodynamic parameters considered were free stream Mach number, Reynolds number and Knudsen number and were calculated for each vehicle using at varying altitudes as investigated could atmosphere of Venus and Mars.

Mars' Environment

In contrast to Venus, however, Mars was greeted in conventional flight that is hospitable, Wagner noted. There is general agreement on values of surface temperature in a range from 200K to 100K, and gravitational acceleration has been determined to be between 34.1 and 35.1 ft/sec². Surface values for Venus are less well known.

Vehicle using problems in a manned Venusian entry were a manned Mars entry now pointed out in another symposium report presented by Peter Leone of Aero Corp., Calicut.



LANDABLE, LIGHTOCULAR REENTRY vehicle designed by Throckmold Studio would enter the atmosphere at a 60 deg. angle of attack and use its rounded bottom as a heat shield. Control after entry is by means of both vertical and horizontal aerodynamic control surfaces (upper right photo) which switch after transition from hypersonic to supersonic speeds.

showed a manned Venus entry vehicle would weigh four times as much as a manned Marsian entry vehicle. Leone considered a direct entry into the planetary atmosphere from earth at hypersonic velocities, landing, instead, with planetary micrometeoroids and earth re-entry. An all-parallel entry vehicle was chosen with a lifting/drag ratio of 5 at 30 deg. angle of attack, 14.5 ft. in length and 14.5 ft. in maximum span for Mars entry.

Weight of the vehicle for a Venus trip was 200,000 lb. compared with 10,000 lb. for a Mars flight, but neither model included the booster recovery to simplify the vehicle to stage speed from earth launch. Weight of the lift/re-entry vehicle was 10,000 lb. Large compressive weight of the Venus vehicle was dictated by takeoff and nuclear heat recuperation for the latter planet. Size of Venus vehicle was adjusted to 80 ft. in length to cross the entry field with a corresponding lift/drag ratio of 7.5. Same size, vehicle was used as the Marsian entry vehicle.

Considerations set in a weight range for the entry vehicles included enough fuel for soft touchdowns into a landing module and launch back into orbit near to Apollo lunar exploration flight plan.

Accurate determination of Mars' surface temperature and chemical composition of gases in Marsian atmosphere would allow more exact model development to be constructed. Lack of knowledge of other parameters at pres-

ent times undoubtedly will rely on test vehicle model atmospheres to determine heating and such basic design criteria as viscosity. Mach number, Reynolds number and Knudsen number, or flows from a design for a wide range of possible values using an engineering model atmosphere.

Neither approach is completely satisfactory. The latter approach of designing within a wide range of probable values is more accurate but is not exact enough for any thing beyond preliminary design work. Instrumented probe and impact probes are expected to provide information needed for specific design work. First U.S. Mars trip-by is not scheduled until 1964.

Extensive Work

Although state-of-the-art in instrumentation, electronics and test facilities, a conceptual manned Mars/entry vehicle at this time, because of the lack of specific design parameters, weights of various or different vehicle designs have presented at the symposium indicate extensive work in this area by industry and government.

Research vehicles and analytical design techniques reported at the symposium included:

• Air Force supersonic re-entry vehicle called SORTITE (Supersonic Test Integrated Entry) designed as a test vehicle to explore aerodynamic, aerothermochemical and performance characteristics in the velocity range of 3,000 to 36,000 ft. per sec during re-

HONEYWELL SYSTEMS



Under the sea or in outer space, the demand for more sophisticated navigational systems continues to grow. Honeywell's goal is to advance the art and science of guidance and navigation equipment and continue to produce quality systems at the lowest costs.



X-20 (Dyna Soar) to be guided by Honeywell system

The Air Force's X-20 (Dyna Soar) program, presently developing guidance and flight control systems. A Honeywell system will supply accurate navigation guidance and pilot's display information from self-contained measurements and computations made within the glide. By means of this display, the pilot is able to evaluate the capability of the glide reaching a given selected destination and, if necessary, can choose an alternate destination. The system will operate from launch until landing and provide uniform control of the craft through a vast range of speeds and altitudes.

Honeywell developed guidance and/or



flight control systems are also in use or slated for use on the X-15, Mercury, Gemini, and Apollo.

Honeywell project exploring the art of celestial navigation

Optics is the key to the future in celestial navigation of space vehicles, and optical devices of many types and varied uses are being developed at Honeywell. One system being studied would actually track several planets by means of high powered radar the latest devices. Range and temperature to the planets would be determined by the tracking devices and the information used to control the vehicle on its proper course.

Consistent with celestial navigation systems development, other far reaching new ideas are being conceived and evaluated to maintain Honeywell's leader ship in the navigation and guidance field.

CHOSEN FOR TOUGHEST NAVIGATION PROJECTS

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For tomorrow's systems capable of performing maneuvers in outer space, Honeywell offers a wealth of experience in the development of navigation systems. Many of our nation's most demanding projects are using Honeywell developed guidance and control systems. Gemini, SD-5, Osiris, and X-20 (Dyna Soar). Honeywell is also building guidance systems for Polaris.

As space missions become more and more complex, the guidance equipment aboard the various vehicles must be capable of more complicated maneuvers.

Systems are needed that do more and weigh less. Today's sophisticated systems must precisely measure everything that happens in a moving vehicle and

guide and control it with precision on an exact course from one place to another, almost anywhere in the universe. All this must be done independently of any earth-based equipment. The need for accuracy is most vital. (A slight error can throw a vehicle thousands of miles off course.)

Honeywell has pioneered in all phases of design, development, fabrication, test and use of such inertial guidance and navigation systems and components. The tests have been many and varied. They range from spacecraft to terrestrial to ocean navigation.

Currently, many advanced navigation systems are under development at Honeywell. We build complete inertial platforms (one-third the size of conventional air-

craft platforms) or are testing modified and offer complete capabilities with no sacrifice in performance or reliability. Conventional sub miniature components and components are also being developed.

Honeywell navigation systems are adaptable to either analog or digital modes. They can incorporate star trackers, horizon scanners, infrared and other optical components where needed for special applications such as space rendezvous and drag space maneuvers.

In addition to complete systems, Honeywell can supply computers, computer components, inertial platforms, and inertial components built to your own or to Honeywell's design.

For more information on how Honeywell can assist you in the development and/or manufacture of navigation systems, contact your nearest Honeywell Military Products Group representative or Honeywell's Apollo, Aerospace Division, 35300 125th Highway SE, Bellevue, WA. Phone 425-480-5151.

Honeywell International, Sales and service offices in all principal cities of the world.

Honeywell system guides Army SD-5 drone

For the Army SD-5 surveillance drone Honeywell designed, managed, and is manufacturing the inertial navigation system. This one-point drone can find its way hundreds of miles behind enemy lines, locate hostile area targets and report back on its reconnaissance missions.

The system can guide the drone over several target areas in each flight without need for any radio or radio commands from the ground. After completion of its mission the Honeywell system guides the drone to its home base. The SD-5's ten-mission inertial navigation system is an all digital type. And because the system is completely self-contained it is not subject to "jamming" or interference by enemy electronic measures.



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AVIONICS

Component Failures Predicted by Infrared

By Philip J. Klein

Bentham—New technique, developed by Bentham shows promise of being able to spot potential component failures in a matter of minutes by measuring their infrared radiation outputs.

Latest evidence suggests that a 5-mm infrared examination can pinpoint transistors which will be the first to fail several hours later. But there's Dr. Riccardo Vanzetti, reported here at recent Northeast Electronics Research and Engineering Meeting (Norem).

Such technique can be used to monitor critical new operating conditions to detect discrepancies from design levels. It also has been used to locate the cause of a malfunction within an item of equipment, Vanzetti reported.

Technique is relatively inexpensive, non-destructive and fast. It is based on the long established fact that the operating temperature of a component is a major factor affecting its reliability and longevity.

Infrared provides a method for measuring the temperature of each component while operating in a circuit without the inconvenience of attaching thermocouples or the risk of changing component temperature by the contact

point process. The intensity of infrared radiation emitted by each component is proportional to the fourth power of its temperature.

Bentham uses a commercially available radiometer, made by Bunker Engineering Co. with a 12-in. focal length Cassegrain optical system. It can detect differences in temperature as small as a few thousandths of a degree Celsius, grade, for more accurate, then required for the new technique, Vanzetti said.

Output of the radiometer is recorded on a conventional strip chart. When suitable calibration factors are applied, the output is a direct indication of the temperature of the component at which the radiometer is aimed.

Component temperature is important for itself and the λ , an indicator of how much current is flowing through the component. This adds to the usefulness of the technique for diagnostic purposes.

Radiometer can detect differences in component power dissipation as small as one milliwatt in operation and twenty-two in stand-by 100 megawatts in pulse discharges, according to Vanzetti.

Specially selected components carrying identical currents and voltages in the same environment should have approximately identical λ temperatures, but

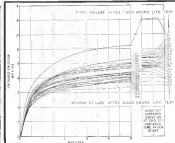
rates and level off at roughly the same final temperature. But Bentham tests show that this is not the case and that the differences may be an important clue to future component longevity.

In one Bentham test, 20 passively identical 2N174 power transistors were placed in test with identical currents. A recording of their temperature rise after application of power was made with the radiometer. Within several minutes the temperature rise of all 20 units had leveled off.

But one of the 20 transistors showed a much more rapid rise, at temperature rise and reached a higher final level than the others. It was the first transistor in the group to fail, after about 1,000 hr of operation.

Another transistor, which had the lowest rate of rise and did not meet what before the others was the second unit to fail, after about 2,000 hr. The other 18 transistors operated at +400 hr without failure.

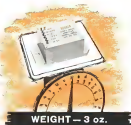
Vanzetti claims belief that it was he made a conclusion that the two transistors, one with an extremely low internal thermal resistance and the other with a very high thermal resistance, were the first and only transistors to fail. But if more electronic methods truly have proved by Bentham's microdetector



INFRARED MEASUREMENTS of components (left), showing temperature and infrared output flow, may reveal potential component failures and provide check on current operation, according to Bentham, which is exploiting the technique. Temperature-over-time curves recorded on group of 20 transistors followed by life test disclosed that first device to fail was one with extremely high temperature rise (curve, right), followed by device with lowest temperature rise. None of others failed during 4,000 hr of operation.

Donner's New* Airborne Amplifier

*New is somewhat misleading. This rugged, reliable operational amplifier has actually been used for more than a year in critical missile applications. What is new is the package, which is smaller and now measures 2 1/4" wide, 3 1/4" long and 1/2" thick. It occupies only 2 cubic inches.



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TOTAL DC GAIN - 250,000 Plus

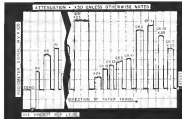


SHOCK - 100g

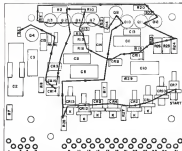
Using silicon transistors throughout, the Model 380F (or for small case) provides high gain, wide bandwidth and chopper stablization paths over a broad range of ambient conditions. Standard model operates from 0° C to +55° C in relative humidity of 95%. Special versions cover -10° C to +60° C. The amplifier will withstand shock of 30 g and meet all specifications to 50,000 feet. Additional technical data is ready now. Call your Donner engineering representative or write us directly.

BRIEF SPECIFICATIONS: OUTPUT ± 10 volts at 4 milliamperes load ± 20 volts at 2 milliamperes load. **TOTAL DC GAIN:** in excess of 250,000. **FREQUENCY RESPONSE:** dc to 100 kHz. **DRIFT:** REferred TO INPUT: 1 millivolts/20° C change, 1% millivolts/24 hours with constant temperature. **JUNCTION CURRENT:** 2 x 10⁻⁴ amperes for full output. **POWER REQUIREMENTS:** ± 15 volts dc (1) and maximum driving 12 volts positive-ground. Inputed 400 cps (2) ms maximum delay. **PRICE:** \$460. Quantity discounts available.

SYSTRON-Donner Corporation **DONNER DIVISION**
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THERMAL PROFILE (top) obtained with infrared radiometer shows temperature and air flow through each component in a closed loop. Radiometer is focused on components to measure shows air flow, with computer readings shows on strip chart above. By comparing thermal profiles of electrical units off production line, out-of-tolerance conditions and malfunctions can be spotted. Further steps.



diagrams show, under reads the temperature will be a powerful tool for working out potential failures with a low cost test procedure in a matter of a few minutes.

New techniques also is useful as on-line strip potential reliability of different circuit designs. It is also useful for quality control of units leaving off a production line.

For those applications, the radiometer is aimed at each component in the circuit as a prescribed sequence. The output is a strip chart recording which

gives a thermal profile of each component in the circuit (see illustration, above). The profile can be made in a matter of minutes.

By comparing the thermal infrared profiles of circuits which are designed to be identical it is possible to spot quickly any component whose temperature control circuit values. This indicates either a potentially faulty component or an adverse build-up of dirt on tolerances causing certain components to operate beyond design



Series Q3700 Digital Pressure Generators by Wiancko utilize a unique digital servo loop network in combination with precision FM components to provide unequalled accuracy and reliability. The ultimate in operational simplicity, this system is suited for automatic end-to-end calibration of data gathering systems—ground checkout of instrumentation and control systems—pressure regulation in closed systems—and programming precision pressure-time functions. With pressure ranges of 0-1 to 0-5 and 0-1000 and 0-2500 psi, and with overall accuracy of $\pm 0.05\%$ of range, this system provides the greatest possible reliability for pressure checkout and calibration requirements. For more information or product bulletin 111D write to Mr. Robert Backus, Sales Manager.

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RAYTHEON

Raytheon AD-50A
Analog-to-Digital Converter



The AD-50A Converter is a product of D. W. RAYTHEON, Raytheon's Analog-to-Digital Converter Division.

least. Vianetti cited a power supply which was redesigned in an attempt to eliminate field reliability problems due to excessive temperature largely from transformer heat.

Before converting the new design to production, however, an infrared thermal profile was run on the original and the revised model. This revealed that while the redesign had drastically cut transformer temperature, a resistor and two transistors in the new model were now operating considerably hotter than in the original model, thereby creating new reliability problems, Vianetti reported.

As a result the power supply underwent another redesign.

Trouble-Shooting

Another use for the infrared thermal profile is in trouble-shooting. Vianetti cited a low voltage regulated power supply which had malfunctioned for an unknown reason.

When a thermal profile was made, showing the relative current through each of its components, the circuit designer was able quickly to pinpoint the trouble to a faulty *zener diode*, according to Vianetti.

The thermal profile of the power supply showed which components were operating beyond original design limits and which were operating far below the design limits.

Vianetti suggested that it might be possible to isolate a variety of different faults in an area of equipment and make an infrared thermal profile of the equipment under each condition, providing a "thermal fingerprint" for each type of fault. "These could be stored in a computer-type memory as part of an automatic trouble-shooting equipment. The latter would make a thermal profile of any malfunctioning device, compare the profile with those stored in its memory and thereby correlate the unknown fault with one identified in its memory."

Microcircuitry Aid

Vianetti pointed out that the techniques now prove invaluable as indicators, traces to microcircuits, where it is now impossible to make measurements within a circuit to determine the circuit's status.

With an infrared microscope, it is possible to measure current flow and power dissipation anywhere in the microcircuit to determine if all elements are performing properly.

Similar technique for thermal mapping of thin-film microcircuits was reported by Philip Schwartz during the recent Electronic Device Meeting which was conducted in Washington (see page p. 93).

Recently, Raytheon noted a new



Minuteman high reliability transformer being adjusted to limited board bracket assembly by MIL-Corbed system.

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THERMAL MAP of a missile target shows temperature profile and infrared heat spots which may cause later failure. Profile was obtained by new thermal plotter (bottom) developed by Philco Corp., which uses lateral scanner to measure noncontact temperature. Technique is made down to true position of 50C and has 1.4 mil resolution. Method is rapid and non-destructive. Plotter plots in meter the thermal microplot plotter nondestructively.



by of various companies to attend a conference looking to the new technology. Companies represented included MC Squibb Division of General Motors Aircraft Control, Buss Engineering, Boeing, General Dynamics, General Electric, International Research Machines Corp., Martin Marietta, Raytheon, Rockwell International and Spacelabs.

An outgrowth of the meeting, an industry group known as the Advanced Techniques for Electronics Committee has been formed to explore and conduct further investigations of the new technology. The committee is headed by J. F. Dettmer of Raytheon's Radar Section Division, with Dr. Vincent as technical chairman.

Merger Talks Terminate

Magnum Corp. and Packard Bell Electronics Corp. announced last week that they had terminated discussions on a possible merger (ENR Oct. 18 p. 31). Magnum's previous interest in Packard Bell's digital computer capabilities was expected to prompt other questions of the Los Angeles company.

NEW AVIONIC PRODUCTS



• **Microstatronics process transducer**, weighing only 5 grams, uses piezoelectric bodies in fluid diaphragms with no moving parts. The type APC-101 provides full-scale output of 300 mV, operates over range of 0.50 psi, has a natural frequency of 25 kHz, hysteresis of 0.1% and an accuracy to within 1% full scale, according to manufacturer Amelco Inc., Electron Devices Div., 361 Moffett Blvd., Mountain View, Calif.

• **Lowest power transducer**, for measuring thermal power from infrared, has lowest power such as 100 mW, first large rocket exhaust, is available with ac



range ranging from 0.1 to 10 milliwatts, with sensitivity ranging from 0.1 to 10 mV/psi. For measuring short duration pulses, transducer can stand over 100 W/psi, says Microstatronics, Endco Corp., 581 South Arroyo Parkway, Pasadena, Calif.

• **Beffer beam forming matrix**, when connected to a Nucletron video unit, provides 8 simultaneous, overlapping isolated beams, each pointing in a different direction and using the full projected antenna aperture. The Beffer circuit is available both in narrow and broadband modes at any operating center frequency between 0.5 and 8.0 GHz. Adjacent beam isolation is quoted at 35 dB. Applications data is

available in Bulletin No. 481. Microstatronics Advanced Development Laboratories, Inc., Haverhill, Mass., 01830, N. H.

• **Modular solid-state circuit breaker**, positive driver for use in d.c. circuits with no moving parts, detects and responds to overloads in a few hundred cycles. Device is available in current



ratings up to 5 amp at 6 to 28 v d.c. for operation over temperature range of -55C to 125C. In current ratings up to 250 mA, device dissipates only 0.15 W. Breaker can be reset by remote magnetism, with 100% duty cycle. Manufacturer Tempco Instrument Inc., East Bethpage Road, Plainville, L. I., N. Y.

• **Locking-type waveguide switch**, Model W31AHL, designed for X-band operation, does not require continuous application of current to keep switch in open or closed position. A 30-msec. locked pulse of 900 mA current is



required to open switch and a 10-msec. locked pulse of same amplitude is required to close it. Isolation is 55 db minimum, maximum loss is 8.1 db maximum and SWR is 1.05:1 for a 100% band, according to manufacturer Waveguide, Inc., 355 West 11th St., Costa Mesa, Calif.

Cost effectiveness in MISSILE SITE SUPPORT?



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Bendix Computer Division

• Memory plane flip-flop tester, Model 2145A, is fully automatic system for making detailed analysis of operation of all types of monostable circuit and



word-programmed numeric memory. System tests continuity and direction of array and vector signals and determines the composite numeric output characteristics. It also generates a variety of programs for testing all phases of memory operation. Maximum scan capability of the system is a matrix of 128 x 128 cells, or an overall total of up to 16,384 words. Manufacturer: Computer Instrumentation Corp., Route 16, Glen Hill, N. J.

• Microcircuit alignment machine, for precision positioning of glass masks and wafers, provides self-aligning water



chuck, adjustable contact pressure between wafers and mask, and a micro-magnetometer control. Bufilex No. 675 gives further details. Manufacturer: Kalsbe and Sells, 115 Conover Drive, Indiana Park, Fort Washington, Pa.

• Large laser crystals, various target-size, deposit glass, are now available in rods in quarter-inch diameter up to five inches long and half-inch diameter up to four inches long. On special order the quarter-inch diameter crystals can be supplied in 10-in. lengths and the half-inch diameter crystals in lengths up to six inches. Manufacturer: Inco

In MISSILE SITE SUPPORT



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KAMAC AIRCRAFT CORP., BLOOMFIELD, CONN.

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for PAYMOVER models

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This blade is 50" high, has vertical hydraulic control and can clear a 20' wide path on or across and ramp areas in one sweep. It is specially designed to retain its snow load through a unique ratcheting action that keeps side spillage to a minimum and eliminates the need for additional passes. A special tipping mechanism permits the bottom of each side plate to follow ground contours. This allows working over uneven surfaces without reducing travel speed.

With only a minimum investment for this dozer blade, you can convert your PAYMOVER tractor into a dual purpose machine that will provide one of the basic tools you need for winter maintenance. Call or write for complete information.



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• Sensitive photomultiplier tubes, Type K 7256, has been the workhorse of previous models in theumble and air subsonic part of spectrum with peak



response in the 7.5 to 8.500 spectrum and range. The 10-amp tube provides surface applications of 100,000 ac coupling to earth stations. Tube receives 11 in. in diameter Monoblock Electronic Tube Division, Altair II, The West Lafayette, Indiana, N.Y.

• Shock monitor system, for use when transporting precision antenna which can be foreign in excess of 100 lb. without external motion, of such design. Device contains vertical and horizontal accelerometers which indicate shock levels above and below value ranging from 1g to 100g. Manufacturer: Kinetics Control Corp., 900 Gann Blvd., Farmingdale, N.Y.

• Defused nuclear diode, gallium-arsenide type GAF 401 emits radiation at about 5,000 angstroms wavelength. Radiation power output of 1 mW can be retrieved at room temperature or more than 25 mW when diode is cooled to



TTC. Diode is mounted in a UC-80/U type monoblock which permits models from at microwave frequencies. Diode is priced at \$175 in single quantities with delivery quoted at two weeks. Manufacturer: Palco Corp., Special Products Department, Lincoln, Pa.

Telstar Silenced After Reliability Record

Many ARE N.Y. Telstar now and features in Telstar developed in the command system, providing ground stations from turning on the common circuit, satellite, transceiver, less than a week after Bell Telephone Laboratories made a detailed report here on the techniques which had enabled it to set a reliability record for U.S. satellites of comparable complexity.

Despite the greatly increased Van Allen radiation produced by the July 9, 1963 high-altitude nuclear test, Telstar performance matched or exceeded original design objectives for more than four months, BTL reported here to 200 industry and government representatives.

The failure on Nov. 23 may be an outgrowth of an rather intermittent malfunction, due to the command circuit. Telstar contained dual command channels, the only redundancy employed, with provisions for ground stations to shut down one channel and check while the other was operating properly. About two weeks ago an intermittent malfunction developed which made it impossible, at times, to shut down one command channel, but this did not affect the basic communication function of Telstar.

In developing, building and delivering Telstar within 15 months of the date that a launch agreement was signed with the National Aeronautics and Space Administration, without great expense in spacecraft design, BTL demonstrated a lower-key aspect of its capability. While BTL is famed for its basic research which has produced solid breakthroughs at the atomic and the laser, its capabilities in hard-core design and prototyping construction is not as well known outside the Bell System.

Reports delivered here by 12 BTL scientists indicate that Telstar was as reliable as a well-planned system approach with meticulous attention to small details which characterizes Bell System developments such as the telephone cable. However, Telstar required a broader spectrum of scientific disciplines than previous Maris III projects, according to one spokesman.

The intricate engineering approach in making design decisions is typified by the choice of design for the tracking wave tube power amplifier used in the Telstar transmitter. Finding wave tubes with comparable power levels as available which weigh less than the 6.75 lb. of the tube which BTL developed and used in its satellite.

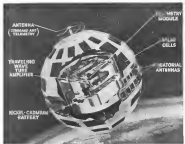
But those lighter weight tubes have considerable lower overall efficiency

than the 30% figure of the tube selected according to D. A. Chiswick. The BTL tube permitted the use of fewer wave cells and batteries with an overall weight saving in the satellite.

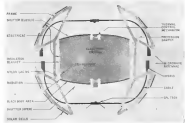
The 15-watt Telstar transmitter used that commercially available as in-house available components but in use whenever possible. But when only life tests on commercially available

components were shown a high failure rate due to leakage and other causes suggesting a low probability of providing two years operation in orbit. BTL design and build an improved cell and there are used on Telstar.

When others have used dual (redundant) equipment design is an effort to achieve satellite reliability, BTL adopted a philosophy of non-redundant



TELESTAR PERFORMANCE was result of painstaking reliability effort, encompassing both components and system design. Details of program were reported at recent Bell Telephone Laboratories symposium. Major elements of Telstar are shown (top). Antenna pointed in center is supported from nylon cable (bottom) in satellite base station. Fixed-link antenna is mounted on each antenna in two deployment, one (bottom) and one (top) mounted by pressure provided by fluidic control fluid.





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design, relying instead upon advanced systems design and component selection. With a component count of 7,355 exclusive of wire coils and mechanical elements, and a design objective of two years of operational life, the sub with a 90% confidence level, components with failure rates averaging one per billion hours were needed, RFL analysis indicated.

To meet this objective, RFL design tried whenever possible to limit their choice of types of components to those which were in high production where manufacturing techniques had been stabilized and extensive reliability data was available.

Many component decisions were used in all applications. For example, no pistons were operated at no more than 50% of their rated ratings, nozzles at no more than 90% of their power ratings and immersion at 10% or less of their rated power.

Resistor Selection

In selecting types of resistors used, designers avoided those that needed a manufacturing technique near its upper limit. For instance, thin film resistors can be produced in values up to about one megohm, but for Telstar only units with values up to 1 megohm were used, Honey A. Stein reported.

To minimize the possibility of a shift in Telstar performance due to vibration or shock during launch, adjustable designs involving adjusting parts were avoided whenever possible. For example, instead of using a potentiometer a series of fixed resistors was employed with the selection of resistance values used to turn up the count to the required performance.

Every component that went into the satellite underwent aging tests, averaging 15 weeks and longer where the Telstar 1 hardware generated. In order to catch defects and to permit adjustment of components exhibiting stable and normal aging characteristics.

Component Sourcing

Any component whose characteristics after aging differed significantly from the norm for that type component even when the difference might result in improved system performance usually was rejected. For example, a resistor which aged less than the norm might exhibit this performance because of two separate faults which temporarily compensate for one another but which in time would be the cause of a failure.

"We treated the unknown even when the effect might appear to be beneficial," Stein said.

Outboard equipment and those using liquid dielectrics were not used because space restrictions might produce gas bubbles and puncture the seal. The bulk

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The system is their concern, not the actual design of hardware. Specifically, they contribute in three key areas: defining the requirements of the system, synthesizing the system, constructing the computer within the system, testing the system, evaluating the system. Throughout they seek to optimize man-computer relationships and to develop a system which grows and changes with the needs of the decision-maker who uses it. Human factors scientists, operational research scientists, systems-oriented engineers and computer programmers interested in joining a

close interdisciplinary effort are invited to write concerning new positions in the expanding field. Address Dr. R. C. Beck, SDC, 2402 Colorado Ave., Santa Monica, California. Positions are open at SDC facilities in Santa Monica, Washington, D.C., Lexington, Massachusetts, Fairfax, New Jersey, and Dayton, Ohio. "An equal opportunity employer."

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of explosive acids, were filled by solid teflon and ceramic types, with a few glass and Mylar units. All turbines expiring were subjected to X-ray inspection at the source to detect any particles which might cause failure.

Most of the semiconductor devices came from the Western Electric military semiconductor production line which a purchasing agent indicates mean for Nike Zeus and other defense programs. Despite this BTL selected only 40% of those put on tape both as being suitable for Tebira use.

Design Tests

Prior to selecting the types of semiconductors to be used, BTL subjected them to device certification tests which included shock tests of 2,000g for 0.3 sec, duration technology tests up to 10,000g and vibration tests of 100g at 50 cps for devices mounted in terminals and 100.2 dB for those mounted on the switching diode.

Design qualification tests also included radiation vulnerability under proton, electron and gamma-ray exposure. These pointed to the need for conducting additional tests during the subsequent training process to select units for upgrade and D-5 Peak test duration levels far below those required to cause total damage to a unit unless one could a significant increase in the collective source current with a corresponding adverse effect on its control gain.

Two types of stress treatment showed considerable degradation under the low level radiation exposure, and were discarded except for one. During the aging screening tests, BTL selected treatment which exhibited the lowest source collector currents for use in the worst control systems. Peak said.

Battery Tests

Early BTL tests on a group of commercially available metal-cadmium batteries showed that 50% of the group had significant leakage of the electrolyte. Although these cells might be suitable for an orbital lifetime of less than a year they were generally a weak link in the Tebira defense objective, L. F. Moore said. Additionally, there was considerable variation among cells in their capacity, according to Moore.

Recognizing that there was not sufficient time to develop a battery new cell, BTL launched a product improvement program in a field where it had no prior direct experience. A non-soluble ceramic seal and improved bearing techniques were devised.

But this raised a new problem because the cell generates gas internally during recharge which in a leak proof cell might produce explosive forces. The amount of gas generated must be

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EDO Left to right above astronomical systems for the Moon, Mars, and Venus.

induced if an excess of electrons is generated in the negative element. To insure this excess signal, the positive and negative electrodes were surrounded in residual gas and the quantity of electrons added was carefully controlled according to the test signal.

The new cells were subjected to qualification tests including 40g vibration from 5 to 2,000 cps in two planes for 14 hr. as well as in the acceleration in two planes for one half hour, with no failures observed. D. C. Roseberger reported. A group of 122 cells was constructed and placed on receiving test in November 1965, with deep discharge and charge cycles to simulate orbital use. By April 1967, another 391 of supposed design were added to the test group.

The seven batteries used in Telstar were selected from the improved design group. Out of a total of 513 cells to test the initial group for a year and the improved design for six months, there has been only one operational failure to date. This was a cell which developed a short circuit, according to Roseberger.

Using an extremely sensitive detection device (water-cooled P H paper), minute leaks have been detected in all of the cells during tests which have been on test for a year, but less than half of the supposed design cells show any sign of leakage after six months of tests.

However, Roseberger emphasized that this leakage is so minute that it has not manifested itself adversely in battery performance. All cells are exhibiting their normal capacities and no excessive, and of charge voltages are found. Despite the major improvement



Miniature Computer

Minicomputer personal purpose digital computer, Model 1-204, with magnetic disk memory of 4,096 words, 10 bits in length words about 140-160 additions, subtractors, true or 73 instructions, multiplexed output 8190 to 2,42 million words. Internal memory permits direct or buffered communication with input/output devices. Edwidge Dumas, General President, Inc.

HH-43B HUSKIE



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KAMAN AIRCRAFT CORP., BLOOMFIELD, CONN.



Infrared Tracker

Martin infrared tracker (left), can be used to guide diesel engine nozzle to its target. Made to carry fishing-related light source which is automatically tracked by Martin driver, compared with precalibrated direction of target to generate signals to aim nozzle accurately. In operation, the tank is opened to weigh 15 lb., as here field of view of 20 deg. for acquisition 1 deg. for tracking, with accuracy of 0.1 milliradians, equivalent to one foot at 10,000 ft. range. Power consumption is only 4 w. Device was developed by Martin Electronic Systems and Product Division, Baltimore.

in cell performance, Benzberger says that tell-tale cells are needed to assure wheel lifetimes of five years or longer required for an operational communications satellite.

The RTL-developed traveling wave tube used in Telstar underwent 1,571 hr. of aging prior to being selected for its significant mission. Frequency data transmitted from Telstar during the first 1,000 orbit shows that beta and collector currents are reasonably stable. The aging current consumption has increased a few milliamperes, but this is an aging characteristic of all tubes which RTL, he noted, D. A. Chisholm reported.

The meticulous attention to detail applied in component selection was carried over into assembly of the satellite payload. Assembly of components into circuitry was carried out by specially selected operators in controlled environment. After each major board was assembled, it was subjected to a very careful inspection by another operator with particular attention given to soldered joint quality. This procedure of inspection at every segment in the assembly is "extremely important," R. H. Shumaker told the conference.

After each major subassembly was completed and had passed all electrical

tests, it was placed in a mold into which polystyrene foam was poured to fill the cavity, locking each component into position. The completed subassembly then was subjected to accelerated vibration and shock tests during which its electrical performance was monitored.

The major encapsulated subassemblies were then installed in the external metal canister, their operation electrically checked and the canister then was filled with polystyrene foam, followed again by tests.

Insulating Blanket

The canister was enclosed in an insulating blanket consisting of about 10 layers of Nylon sheathed on both sides and separated by 1/4 in. fiber spacer to minimize radiant heat transfer from the canister to the satellite skin. The insulated canister then was placed on the satellite shell and supported from its frame by means of nylon lacing which provided vibration isolation and minimized heat transfer to the skin by conduction.

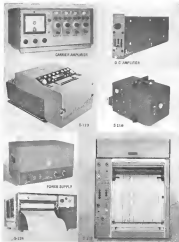
Temperature control of the canister is provided by two metal diaphragms, one above and one below the canister, which are spring loaded closed. Internal pressure operated by positive charge fluid, whose pressure varies with temperature, overcomes the spring forces to open the cover. The design calls that when the canister temperature is 50° the diaphragms are fully closed and at 100° they are fully open, allowing external heat to radiate to the satellite skin.

Telemetry data indicates that Telstar's payload reached an equilibrium temperature of 74° within the first day after launch, a figure which was within one degree of the calculated mean temperature 1 W. West reported. Since first time the temperature has dropped slightly because the satellite is spending more time in the earth's shadow. The day last week reached the temperature of the satellite's payload has held within 1/2 deg.

Dammy Satellites

In recent microwave development and test at an initial contract, RTL constructed a number of "dammy" satellites. West indicated. One was used to develop and test the satellite as a dummy satellite but were used to measure vibration levels for various shock and pressure, while two more were used to check out the operation of the temperature control system.

In addition three substantially complete Telstar satellites were constructed, one to serve as a nominal development model and the other as an electrical development model. Finally, a prototype unit was built and subjected to a full range of environmental and op-



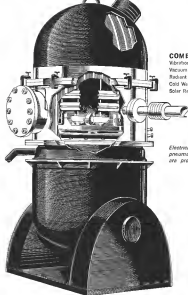
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POTENTIOMETERS	Rev./200 Ω			
Linear	CH00121100	0.6	500	0.04%
Geometric	CH00121110	0.445	500	0.05%
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external tube, followed by the last light model.

The ability which Telstar's solar cells have demonstrated in withstanding the extended Van Allen radiation produced by the Feb. 9 nuclear test reflects extensive effort which BTL put into design of Lufkin's power system.

The decision to back up Telstar with and use the newer, more radiation-resistant Non-P type cells resulted in part from extensive radiation tests which BTL conducted using a Van de Graaff generator. These tests indicated that the newer type, despite an initially lower power output, should exhibit significantly greater longevity in the presence of the natural Van Allen radiation. H. G. Conrad said.

While most previous satellites have used fused quartz to shield solar cells against radiation and microcosmic damage, BTL's investigation of many materials prompted the selection of sapphire in 36 and thickness for its increased radiation protection. Because sapphire has inferior heat conduction characteristics, BTL had to devise an exposed means for cooling the solar cells. This was accomplished using a solar cell mounting plate which transferred heat from the cells to the satellite shell by means of silver clips and platinum wire strips. R. J. Nielsen and American Telephone & Telegraph Co. earlier had declared plans to launch Telstar 2 because Telstar 1 was still operating and had earned out all of the originally planned experiments. If the second Telstar 1 malfunctioned, they said, they, the company, will consider its replacement.



Spaceborne Radar

Spaceborne radar prototype, called Decar on acronym for digital electronic continuous ranging, can measure range and reflector-free distances of thousands of miles and velocities from thousands of feet per second to less than one foot per second, according to Fordham State-Electronics Systems Division. System measures phase-shift resulting from propagation time in digital wave-form processing technique use of microwave conduction techniques.

ENTER FILTER CENTER 22182

► **Manned Spacecraft Center Competition**—Industry proposals for the job of supplementing Manned Spacecraft Center's Integrated Mission Control Center (IMCC) and integrating the Ground Operations Support System (GOSSES) into IMCC are due at Houston, where IMCC will be located, on Dec. 7. The multinational firms entered control center is expected to be the hub of Apollo and subsequent phases of Gemini missions, such as Mercury control center has been in the manned Mercury flights. Ten agencies submitted proposals to bid are Bendix Radio, General Electric, Hughes, International Business Machines, International Telephone & Telegraph, Lockheed Martin & Space, Philco, Radio Corp. of America, Raytheon and Sperry Technology Laboratories. Philco's Government and Industrial Division, Palo Alto, Calif., which has been conducting NASA-funded studies of all phases of Apollo and Gemini ground control since last year is expected to be one of the leading contenders. IBM, previously (AW Nov. 22, p. 38) was selected as associate IMCC contractor for a control, real-time data processing facility and a separate computer facility system which later to be incorporated into IMCC will be held there. (AW Nov. 12, p. 38) Besides the computer facility, IMCC will include communications, modulation, station control and RF receiving and transmitting facilities. The system's contractor will handle detailed system design, equipment procurement, system planning and integration and IMCC activation.

► **Electric Propulsion Applications** Defined—Switching electric propulsion system applications and systems are expected to be built by Hughes Research Laboratories for the Lunar Research Center is expected to control attitude of advanced 24-in. satellites to ± 1 deg, and their position to ± 0.1 deg. Each of the nine engines will have specific impulse of 4,500 sec and the continuous thrust output will provide 1 of a thousandth of a pound thrust and the three station keeping engines 15 thousandths of a pound. Average power required by the 12 ft system will be 117 v. Power supply consisting of solar cells and batteries will weigh 75 lb. The system will have nine thruster directions at four times-per-revolution and one outboard jet station keeping and one for low-orbit attitude control. Attitude control engines will employ unusual arrangement of knee strips, experimental screens of which recently was built by Hughes.



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WING OF THE DE HAVILLAND DH-125 is swept 26 deg. and is almost all fuel tankage. Wing struts are extended below the wing to save material and allow more. They greatly strengthen the DH-125. A number of system components are mounted in wing fillets and the tail cone. Follow-on variants may have more powerful engines and a 370-gal fuel tank in fuselage forward of wing root.

More Range, Power Planned for DH-125

By Herbert J. Coleman

Hatfield, England—De Havilland Aircraft designers are working on follow-on versions of the DH-125 executive jet that will extend its range and power.

Immediate focus of the airplane is covered by an order for 22 from the Royal Air Force (AW Sept. 14 p. 11), one from Bristol Siddeley Engines for engine development and another from Kvaerner-Brown, a German cluster engine. "Not more, will be to improve those of the Bristol Siddeley Viper Mk. 520 powerplant and to design tail tankage which will not affect the stem wing."

At the moment, and that is subject to change, the De Havilland design team is

working on a tank structure involving a 150-gal tank which would be fitted to the forward fuselage ahead of the leading edge. Work was previously sought by the Royal Air Force, which wants additional flight time available to the airplane as well as to a conversion and VASAR trainer.

De Havilland is striving such tankage conditions as top or slapper units on the wing. Fuel configuration will be a variation of the tank now being installed on the RAF workshop at Hatfield, England.

To broaden potential sales of the DH-125, De Havilland is working closely with Bristol Siddeley on an advanced version of the Viper now rated at 3,000 lb. takeoff thrust. That engine is also

specified for the Douglas Pegasus Viper jet, one of De Havilland's competitors.

The engine company's design effort is aimed at a version of the Viper which will produce 3,450 lb. thrust without reducing the overall base of about 500 in. This version would increase DH-125 conditions at low weather conditions and at high altitude reports.

To obtain higher thrust, Bristol Siddeley is studying use of new materials to increase the Mk. 520 Viper's 1,074K. right temperature limit.

Since the DH-125 production version was laid down, there have been five or six design changes. Top fin is now a fixed unit and a fuel-sloped fitting has been added to improve motion at high cruise speeds. All production mod-



PRODUCTION OF THE DE HAVILLAND DH-125 executive jet is under way at the company's Hatfield, England, facility. First airplane, which was demonstrated at the annual Farnborough Air Display, has been fitted with flow patterns during wind-tunnel testing.

els will incorporate a larger front door which is raised and retracts upward to fit flush with the fuselage and

C. T. Wilson, De Havilland's chief designer and a member of the board of directors, says the DH-125 "acquires extra for a fuel tank, trouble-free, long-life life of 10,000 flights—no flights, then, seven days a week for 15 years. Through the company's connections with the British Siddeley Group, De Havilland will also develop an engine and engine service backup network, in various areas of the United States which it considers its major market. Through this plan is based on the Viper, De Havilland has done considerable study of the General Electric CF-610 for U.S. agencies. Particular interest is in the 610's low version, the CF-700.

First two DH-125s are now being assembled at Hatfield, and the next six being built at De Havilland's Chilton production facility. Initial launch is 30. At the same time, part of De Havilland's design team will continue to work on the proposed DH-125, a larger version aimed at the feeder-bus market. Discussion on a go-ahead as far as a prototype is concerned, said in the future.

On the line of flight tests, Wilson feels that the DH-125 has met its design requirements, including:

- Simplicity in fuselage and wing design to get into and deliver power, and to reduce maintenance problems.
- Capability to carry in its eight passenger seats for flights of up to 4 hr on stages of 1,500 mi or more and to operate from short fields.

Decision to design an airplane with a cruise speed of 500 mph would

necessity for an extreme wing sweep and sealed fuselage and for the complete range of installing power controls. The wing contains fuel tanks, and each engine is fed from the tank on the same side to eliminate the need for in-flight switching. Certified is available, however.

Wing, which is under the main base structure and divided on the upper surface of the center section for mating to the body, is built as a single section and is attached to the fuselage at five points. Tankage is provided from front to rear, and from tip to tip, divided into the two main compartments. Main span extends from the center section to the wing tips, with a center span extending about two-thirds of the span.

Upper wing surface consists of two continuous sheets of non-bearing skin. Main span also extends at the root, as the center section cover plates. Struts are utilized by spacing stronger and reinforcing plates. Reduce loads to the under surface at the rib stations. Copied because skin is used for the bottom skin, which contains an aileron closed by load-carrying down.

Fuselage is a continuous structure and both consist of less than 100 components. It is made of steel, with the center skin reinforced by stringers. Side bar is a continuous structure.

Main fuselage is 6 ft 4 in. diameter cylinder and has an unsupported tail cone at the present design. Groups in service to that of the De Havilland Trident three-jet transport. Skin is made of copper-bearing aluminum alloy with bonded stringers and with circumferential frames. To resist low stress levels,

designers used bonded metal wing struts at the main points.

Window design, which also follows that of the Trident, with the controls rendered by a double glass and a heavy glass window pane. Window itself consists of two panes of Plexiglas. Each will carry precompression loads alone.

Without and the basic structure is designed on side-by-side principles in a playing aerodynamic and bonded metal wing struts. Wherever these features have not been applicable, components have been designed of high tensile steel.

Flaps are double-slotted and extend for more than 35% of the wing span and comprise 25% of the chord. Flap position is 45 deg. for takeoff and 50 deg. for landing. Speed brakes on the top and bottom surfaces of the wing flap flap down when extended. Flap speed brakes tend to reduce, however, 50 deg. of flap extension is available.

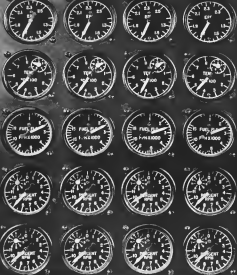
Traveling landing gear is hydraulically operated and pilot has a raw, wheel steering control. Tire which was incorporated in the design deliberately for use in rough ground conditions. The main wheels are staggered about 3 in. to allow them to fit smoothly into the wheel well and that eliminate the need for cover doors, but the nose wheel is centered by a door. Tail brakes are operated through Masteract with a pressure wheel locking.

A DH-125 fuselage, a case in the water tank at Hatfield for stress test cycling and measurement on the basic fuselage, and for other pressure tests. Pressure is provided by air bled from the last stage of the Viper engine con-



DOUBLE-SLOTTED FLAPS on the DH-125, which may be deflected a maximum of 70 deg. as before, are controlled. Slot is one opened by flap down when flaps are raised. Speed brake is on upper surface of wing. Bristol Siddeley Viper engine can be reached from ground level. Cool ports surrounding the Viper engine are detachable for ease of maintenance.



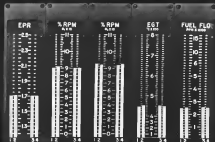


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It is not as sophisticated as our electron microscope or our hypersonic shock tunnels, perhaps, but it is of use to physicist. Tom Meo as he names a research program of his own choosing. In this program, Mr. Meo is using Cornell Aeronautical Laboratory funds to study water surface behavior under controlled conditions. With a modified Doppler shift he is trying to identify primary bubble scattering elements in the wave surface and determine their behavior as the state of wave motion is changed. Waves generated at one end of a long tank spread themselves on a "beach" at the other end. The idea is used to shape the beach.

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FINANCIAL

Financial Briefs

Boeing Co. reported net earnings of \$21,378,800 for the first nine months of 1962 on sales of \$1,268,864,899. Comparable figures for the first nine months of 1961 included net earnings of \$20,073,680 on sales of \$1,205,766,069.

Douglas Aircraft Co. earned \$6,351,487 for the first nine months of Fiscal 1962 on sales totaling \$351,718,852. Same period last year showed a profit of \$5,495,919 on sales totaling \$416,213,249.

Northrop Corp. had earnings of \$9,051,123 for its Fiscal 1962 ended Feb. 29 on sales of \$347,469,587. This represents a 30% increase in sales and a profit increase of about \$178,000 over Fiscal 1961.

Manpower Corp. reports earnings of \$1,519,380 on sales of \$39,114,405 for the first 46 weeks of 1962. For the same period in 1961, the company reported sales of \$34,955,185 and earnings of \$1,712,741.

Boyc-Warner Corp. earned \$419,941 for the first nine months of 1962 on sales of \$496,513,276. Figures represent a 12% increase over earnings for the same period last year of \$38,312,628 and a 11% increase over the \$481,214,698 sales reported a year ago.

Metecon, Inc. had earnings of \$9,070,000 for the first nine months of 1962 on sales of \$244,700,845 compared with earnings of \$6,616,842 on sales of \$207,707,789 for the same period in 1961.

Radio Corp. of America earned \$14.1 million on \$1.51 billion in sales for the first nine months of the first nine months of 1962. Earnings for the same period last year were \$15.8 million on \$1.34 billion in sales. For the first nine months of 1961, the company reported earnings of \$14.1 million on sales of \$1.51 billion. Third quarter 1961 showed \$6.2 million earned on sales of \$158.5 million, or \$0.12 per share.

Sudgen Associates, Inc., Nathan N. H., had earnings of nearly \$7.01 million on \$1.54 billion in sales of \$1.54 billion for the first nine months of 1962. Last year figures were \$580,000 earned on sales of \$31.4 million, or about \$0.01 per share.

New Procurement Rules Spur Incentives

By George C. Wilson

Washington-Defense Dept. will issue significant new changes to its rules for procurement officers to make it more difficult for contractors to win money by misrepresenting costs and to encourage the aerospace industry to find ways to economize in developing and producing military items.

The forthcoming additions to the Armed Services Procurement Regulations (ASPR) will be issued this month or early next year, and are an important part of Defense Secretary Robert S. McNamara's general strategy for achieving the economy he has promised President Kennedy.

McNamara's basic contention is that the quickie approach the government and industry to enter into a new type procurement contract is more costly than the long-term contract. Traditional methods and develop techniques which permit to cut time and money.

That a forcible rebuke to this attitude is the Reorganization Board, the new board body charged with the task of making over military contractors. The board has the right to demand that contractors return excessive profits to the government. The board, the new board and the new rules are often designed in the past as cost-cutting economic profits.

Cash Incentives

McNamara and his deputies fear that cash incentives in the way to build into defense contracts are not accepted by the Reorganization Board as excessive profits. This could cause a loss of money for the contractor. The board has the right to demand that contractors return excessive profits to the government. The board, the new board and the new rules are often designed in the past as cost-cutting economic profits.

The regulations, now in final form, direct Defense Dept. personnel to keep the Reorganization Board fully informed about their contracting action as they go along rather than at the end. The rules restrict the procurement officials to limit the board with their information as the contractor's record for delivering on schedule, how effectively he met deadlines, and how he allocated to the project, money, or developing new materials that do the job at less cost, with less risk, and efforts to substitute work to meet business and where surplus arise. In short, Defense Dept. wants to give the Reorganization Board so much detail that it can make the performance of the contractor itself instead of relying merely on the financial figures furnished to reveal

whether the profits were excessive.

In a recently published executive contracting guide prepared for the Defense Dept. by Hurlburt Hays, Inc., of Boston, procurement officials are told that the Reorganization Board is not employed to recover unusually large profits; that cash incentives placed into contracts will not necessarily be subjected to severe provisions.

Defense Dept. also sets to meet statements by Chairman Lawrence E. Hingst, of the Reorganization Board, indicating roughly his incentive actions. On Oct. 26, for example, Hingst said that in developing when profits are a definite contract is excessive, the board would "consider" if these complex factors to that (among other things) the products who is most efficient who is most successful, who has made the greatest contribution to the defense effort and who has most capital at risk, who keep more profit than the producer who makes these factors to a loan cost.

ASPR requires for the Defense Dept., Reorganization Board and aerospace industry to track in understanding on contracts, contracts in the U. S. Tax Court practice of calculating what is the net profit from a contract, not profit.

ASPR on Jan. 10 ordered the Boeing Co. to return back \$15 million of its profits in 1952. Boeing's profits in 1952 on sales of \$1.5 billion, or about \$0.12 per share. The board has the right to demand that contractors return excessive profits to the government. The board, the new board and the new rules are often designed in the past as cost-cutting economic profits.

ASPR on Oct. 26 directed North American Aviation to return \$10 million in excess profits on its government contracts in 1954. Judge John G. Maloney, presiding over the North American Inc. trial calculated excess profits in the same manner as did Judge Wilkey, then making a severe loss to the company in particular and incentives in aerospace contracts (AW Nov. 5, p. 41).

In short, the U. S. Tax Court has not seen fit to rule that excessive profit, accurately paid, superior profits. Defense Dept. wants to give the Reorganization Board so much detail that it can make the performance of the contractor itself instead of relying merely on the financial figures furnished to reveal

whether the profits were excessive.

the McNamara team also intends to use cash awards as the incentive to encourage contractors to use more efficient techniques. Defense Dept. officials will take this into account. They will consider the problems to procurement officials by using ASPR as a tool to build more value engineering into contracts.

Value engineering claims will give the contractor a share of the savings gained by doing such things as simplifying designs and introducing materials which cost less without impairing quality. One idea under discussion is the Pentagon is to have the engineering team composed of a value engineering team composed by the contractor full time on a project. After the government is notified of the savings, the team, the savings the team offered would be split between the government and the contractor. One suggested formula is to spare the government's investment in the project, the savings the team has earned and then split the remainder of the savings 50-50.

Value Engineering

Thomas D. Moore, assistant secretary of defense for consultation and logistics, is especially enthusiastic about the money-saving possibilities of value engineering. In the conference notes on the money-saving money through engineering or material changes. Mainly told American firms that the Defense Dept. is determined to make value engineering more of a habit in industry.

Contractors are urged to show the Pentagon's value engineering campaign and at once make fully valid. The Defense Dept. has a way to give extra approval to contractors' money, saving them. Mainly told American firms that the Defense Dept. is determined to make value engineering more of a habit in industry.

Some contractors do have the past good luck with value engineering techniques the property of the government. "Giving that man a good man's money," and not, now, aerospace contractors. Mainly told American firms that the Defense Dept. is determined to make value engineering more of a habit in industry.

The type of value engineering team Defense Dept. is trying to form will include experts in engineering, materials and business. The key lies within the Defense Dept. and within the defense industry. Mainly told American firms that the Defense Dept. is determined to make value engineering more of a habit in industry.

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- Motors, Pick-Offs

working." His end goals must be set and specific value engineering projects identified. Value engineering should apply both in the development and production stages, Morris said.

The Martin Co.'s Orlando Division is out of the defense contractors which has set up a full time value engineering team. George J. Parker, the division's administrative director, recently told a small business forum in Orlando, Fla., that "we are fast approaching the point where we cannot afford to do without ourselves. We need a concentrated value analysis program in our rooms, we need for the defense industry, adding 'members in the key' word in the success of our program."

Martin-Orlando has a five-member value analysis team working on the Bellup air engine model. A cost-plus spokesman said the team discussed the cost of the engine by 1975 between the time the first production model was finished in 1972 and now. Bellup's value analysis team includes engineers with manufacturing and design experience, material specialists, and finance and personnel officials.

Defense Dept. leaders insist that contractors value give the government less for its money than other contractors. The records published "The Force, Gladly for Peace" state that value is the line of a warning to procurement officials negotiating contracts. "It is not unusual for an otherwise highly competitive company to turn a sharp corner for government work as separate operations applicable to government work, and thereby lose some of the obvious advantages noted in their competitive commercial operations."

Government Controls

In the immediate future, the economy plan will require more government controls in procurement efforts to write the Defense Dept. a philosophy into contract clauses. But if the Dept. does succeed there is a promise for less government control over the management of industry.

The newly-published executive contracting guide says "Without question one of DOD's primary objectives is providing the use of multiple objective contract is to improve the quality of industrial managerial control over the country's large development program. In fact, under a proper system contract the amount of cost covered will depend directly on the contractor's ability to achieve the maximum cost-effectiveness by lower costs, better delivery and/or higher quality performance."

"What will be required," the guide continues "is more sensitivity in existing program control procedures and increased management interest in the information these procedures generate."

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National Aeronautics Corp., Fort Worth, Texas, Tex.

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Gaussmeter is all-transistorized direct reading and operates on the principle of sensing a second wire coil at high speed by a precision microswitch motor. Out put signal is directly proportional to the magnetic field and is read directly from a precision meter calibrated in gauss.



High accuracy in electromagnetic susceptibility fields can be measured and interpreted composition is incorporated in the design of the device. Alpha Scientific Laboratories, Inc., P.O. Box 111, Berkeley 1, Calif.

Automatic Direction Finder

Automatic direction finder which is self-powered and is standard commercial broadcast ground or ocean radio station weight 5 lb., according to the manufacturer.



Direction finder, designated ADP-11, has low-voltage antenna connected to a low-impedance loading 2 in. deep

ing with inherent expansion to produce an interaction between pump discharge and expansion. This which is better than the use of the individual pump. The new, principle allows for faster pumpdown and higher vacuum during outflow, conversions.

Used operators exhibit low electric power rate while using or submergence are required to produce a constant low vacuum in the 10⁻⁴ torr range using vacuum.

Utek Corp., 920 Commercial St., Palo Alto, Calif.

Aerospace Lubricant

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The Aerospace Vehicles Laboratory of the Space Systems Division has openings for nearly one hundred engineers who have experience in stress, structures, propulsions, mechanisms, control systems, equipment installation or heat transfer which can be applied to advanced aerospace weapons systems or vehicles. The Aerospace Laboratory is concerned, as a result of SURVEYOR and other contracts, with lunar and space exploration, air to air missiles and ICBM defense systems. The openings are for both junior and senior mechanical engineers, electronic engineers, physicists and aeronautical engineers. Some of the openings are described below.

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Senior Dynamist. Must be capable of performing advanced analysis in structural mechanics. Will be required to calculate response of complex elastic systems to various dynamic inputs including random excitation. Must be capable of original work in developing advanced analytical techniques.

Load Analyst. To establish structural design criteria for advanced missiles and spacecraft. Should be capable of determining external and/or inertial force distributions.

Reliability Analyst. To perform statistical analysis of structural loads and strength properties for the purpose of establishing structural reliability criteria on a probabilistic basis.

Stress Analyst. To perform advanced stress analysis of complex and redundant elastic and semi-rigid structures. Will be required to solve special problems in elasticity, plasticity, soil-structure and structural stability.

Design. Experience is required in preliminary and final structural engineering and design, including preliminary stress analysis. A knowledge of the effects of extreme temperature variations

and/or heat vacuum, plus a background in materials is desired.

Heat Transfer

Space Vehicle Heat Transfer. Basic knowledge of radiative conduction and convection heat transfer with application to thermal control of space vehicles is required. Knowledge of specially selected reaction cooling, supercritical flow and thermal energy testing is of particular value.

Aerothermodynamicist. Experience in hypersonic test gas dynamics, heat transfer, advanced entry vehicle design, reentry, shock layer, vortex and rocket exhaust simulation, and aerodynamic system requirements will be most useful.

Equipment Installation

Packaging and Installation Engineer. To perform software packaging and installation design for missile and/or spacecraft units, considering amount and geometric shape of loads available as well as weight and center of gravity distribution requirements. Must be capable of analyzing structural adequacy of unit under extreme environmental conditions.

Controls

Control Devices. Design, development, procurement and test operations are involved. Considerable experience in the field of optical devices for space applications such as star trackers, sun and moon trackers.

System Test. To plan and supervise the operations of a flight control system laboratory. Air handling tables and a wide variety of optical mechanical and electronic equipment are involved.

Control Systems Analysis. Requires experience at various levels of experience including personnel capable of taking over all project responsibility in the synthesis and analysis of control systems.

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If you are a graduate B.S.-M.S., A.E. or engineer with experience comparable to the above openings, please a mail your resume to:

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Electromechanics. For studies in strong aerospace and field theory pertinent to such areas as communications, antennas, radar, guidance, and plasma effects.

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Experimental aerodynamics. To work with a group that will support theoretical aerodynamic research with experimental approaches and will indicate experimental results to fit needs in the theoretical techniques.

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Guidance and controls. To conduct study and analysis of sensors and navigators.

Systems research. To work on systems performance applications.

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Avionics. To work on the design, development, and analysis of avionics systems for airborne applications.

Reliability. To assess the reliability and optimize the configuration and redesign phase of space systems.

Chemical research. To work on the development and applications of structural techniques for aerospace vehicles.

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EE, with heavy design experience in high-power amplifiers for communications, background in design of solid state control circuitry and amplifier circuitry in UHF through VHF ranges.

ME or EE, with at least 2 years' experience in electrical design and testing of multi-megawatt, power, and semiconductor cables and conductors to mid space. If no ME, must be familiar with basic principles of electrical



engineering such as alternators, transformers, etc.

Project responsibility as microwave communications equipment designer. Must be capable of supervising design and applications of microwave systems and equipment. Able to handle all phases of proposal preparation.

BSCE or equivalent, with 5 to 10 years' experience in test equipment design and engineering, redesign of equipment for manufacturing, radio transmitters and modulators. Able to handle all phases of proposal preparation.

EE, with several years' experience at major research organization, good background in solid state theory. Specific duties and responsibilities will involve research and theoretical studies in electron tunneling phenomena in this field, broad knowledge of wave potential conduction.



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Data Processing Analysis Manager, with 4 to 6 years' experience, including analysis and programming on a large scale digital computer; knowledge of diagnostic, utility and space

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General area resume in full confidence to Mr. M. J. Smith, Director, ITT Federal Laboratories, 100 Washington Avenue, Nutley, N.J. 07110. An Equal Opportunity Employer.

WHO'S WHERE

(Continued from page 23)

Honors and Elections

Wilford W. Minkins has been elected president of the American Fighter Aircraft Association. James L. Bonds, vice president, and Alvin Minkins, a board member, are also in the association. Minkins is a board member of the USFV Air National Guard and a member of the USFV Air National Guard and a member of the USFV Air National Guard and a member of the USFV Air National Guard.

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DESIGN AND DEVELOPMENT (MS, PhD) Student for advanced rocket engine design in solid or liquid systems and common auxiliary design related.

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DATA DYNAMICS (MS, PhD) Student for advanced rocket engine design in solid or liquid systems and common auxiliary design related.

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STATISTICS (MS, PhD) Student for advanced rocket engine design in solid or liquid systems and common auxiliary design related.

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SYSTEMS ENGINEERING Determine characteristics of energy conversion and power systems that are technically and economically feasible for development efforts. Data include the analysis and evaluation of specific systems capabilities and performance in the general analysis and experimental development projects (Conceptual only).

EXPERIMENTAL TEST Develop test procedures, develop test facilities, test rig, equipment, instrumentation and test procedures, conduct test analysis, data, formulate test conclusions. Requirements are available in both air breathing and non air breathing programs ranging from overall gas turbine engines to fuel cells.

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OR

MR. J. D. BORTON
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FLORIDA

Many other openings of various experience levels are also available in ongoing programs. If your specialty or field of interest is not listed here, write us anyway.

Pratt & Whitney Aircraft

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GENERAL ELECTRIC TO SUPPORT NASA IN FORMULATING DESIGNS AND EQUIPMENT FOR CHECKOUT OF THE APOLLO SYSTEM



The National Aeronautics and Space Administration has assigned to General Electric a major role in designing and developing integrated, automatic checkout and test equipment for the APOLLO program, in addition to supporting NASA in overall reliability of the entire system. High level specialists and systems people are being drawn from many components of the company to contribute to the design and development of computerized aerial automatic and automatic checkout systems. Additional highly qualified engineers and scientists are needed now.

Assignments at HUNTSVILLE, DAYTONA BEACH, CAPE CANAVERAL and HOUSTON

Engineering experience required in
SYSTEMS and SUBSYSTEMS CHECKOUT and TEST PLANS, DESIGNS and OPERATIONS

Electronics • Electronics • Mechanical • Conversion and Guidance • Propulsion • Instrumentation and Communications • Telemetry • Pyrotechnics • Vehicle Systems • Systems Specifications and Designs • Digital Command Systems • PCM • Computers • Display • Analog and Digital Simulation • Test Simulation • Vibration Analysis • Space Mechanics • Operational Support Systems

If you have experience in any of the listed areas, write us today (include salary requirements). Your inquiry will be held in strict confidence. Write to: Mr. P. W. Chelton, Personnel Placement, Section 64-WY Apollo Support Department, General Electric Co., Administrative and Engineering Bldg., Daytona Beach, Florida.

APOLLO SUPPORT DEPARTMENT

GENERAL ELECTRIC

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ADVANCED ADVANCED SYSTEMS RESEARCH ENGINEERING

**NEW DEPARTMENTS
NOW BEING ESTABLISHED AT BELL AEROSYSTEMS**

Known for such "firsts" as INSERMES, the most accurate, precise inertial self-compensating navigation and guidance system known, but is increasing its company sponsored R&D and further expanding its programs in America. Interesting new developments are about to start in such varied areas as: (1) a laser-based "look" air module, involving development of advanced experimental techniques for ultra accurate measurement of stability, and new concepts in ballistics surveillance systems and air traffic control.

POSITIONS ARE IMMEDIATELY AVAILABLE FOR:

SR. PHYSICISTS & ELECTRONIC ENGINEERS

MS or PhD with 5 years experience in physics, optics, optics and guidance. To work on company sponsored R&D programs on microwave navigation, laser, ranging systems, new guidance and control techniques for space vehicles.

CONTROL SYSTEMS & SIMULATION ENGINEERS

Systems and control systems design experience in automatic guidance control systems, computer-aided navigation, closed-loop TV and video design. MS or equivalent degree in EE, PE or a related engineering discipline, with 3 years experience in control systems and electronics control systems, feedback theory, analog computer simulation and software.

Now inquiries are invited. Please send resume to: Mr. F. D. Pritchard, Dept. 30.



SR. ELECTRONIC SYSTEMS ENGINEERS

MS or PhD in EE with minimum 5 years experience. For systems and analysis work involving air traffic control, range location, range radar, navigation and control, visual observation and for flexible control systems.

SR. ENGINEERS & PROJECT MANAGERS

BS or advanced degree in EE plus 10 years analytical experience radar and systems experience a desirable. For development of pulse processing equipment and data link systems with open file management, with emphasis on multi-channel radar, telemetry and navigation, precision range distance measuring equipment, rapid frequency air velocity techniques, and increasing the power range and reliability of radio command and communications systems.

A Message to the Engineer/Scientist Community At Large — and a Question: *What's a dynamic technological race going on at the Atlantic Missile Range, a race between the best increasing capabilities of new missiles and space vehicles and the capacity of range instrumentation to test their performance? □ We wonder how much you have heard about this... □ And about the challenge it offers engineers and scientists with PAN AM at Cape Canaveral? □ You may know a small segment of the work... many do. But only a handful are aware of its scope. In fact, we of PAN AM'S Deep Missile Range Division sometimes think that only the ubiquitous newsgirls know the full story of the new range instrumentation technology we've created in the 9 years we've been charged with development and management responsibilities for AMR by the U.S. Air Force. □ The essence of the discussion we've come to the essence of the technological jump between MATADOR and MATHEW. □ In the simplest terms, this has meant improving our position, loads of data, of our higher accuracy, of our greater distance — and correcting and transmitting it in ever increasing speeds. □ THERE, the existing range instrumentation and communications techniques were pushed to the utmost bounds of their capabilities — THEN they were replaced with new range systems built to new standards, as specified by PAN AM engineers and scientists backed by research groups. □ Today — a new phase of range technology development is under way — and build up to producing on schedule. □ We meet the demanding requirements of both today and tomorrow, much of the work of the Range is divided into three time projections:*

- (A) designing and implementing range instrumentation for launches programmed for this year and next;
- (B) developing range technology concepts required for launches in the near future (Delta Stars, Gemini, Apollo test vehicles, advanced Space boosters and Nova);
- (C) advanced planning, looking forward as much as 15 years. Includes considering such problems as how to service, launch, track and recover information from multi-mission pound thrust booster systems and outstripping the problems associated with the launching and support of reusable propelled boosters and spacecraft.

OPPORTUNITIES are open right now to join Pan Am in developing range test systems of hemispheric, global and celestial scope. □ **SYSTEMS ENGINEERS** (E, G, Physicist) — capable of accepting project responsibility for design of range instrumentation systems, monitoring systems development, installation and acceptance. (Must also be adept at liaison.) Background in one of the following areas is essential: Pulse radar, CW techniques, telemetry, software, data handling, communications, closed circuit TV, frequency analysis, command control, command guidance, underwater sound, ranging. □ **INSTRUMENTATION PLANNING ENGINEERS** (EE, Physicist) — with managerial capabilities, to accept responsibility for specific global range instrumentation concepts. Must be able to comprehend overall range instrumentation concepts and have extensive experience in one of the following areas: radar, telemetry, infrared, optics, data handling, communications, underwater sound, shipboard instrumentation. □

QUIETLY...

a whole new range technology has been created

SENIOR ENGINEERS & SCIENTISTS / FORWARD PLANNING (PhD's, MSc's, Physics Applied Mechanics, Astronomy, Electronics) — to evaluate and project the state-of-the-art in all applications to range instrumentation. Help establish both theoretical and practical limitations of existing relevant technology. □ In addition to all the necessary professional values, you get Florida, too! Those who enjoy coastal, year-round, outdoor living are in their element at the Cape, where a majority of engineers and scientists live and play near the water. Consider us that PAN AM gives you a 90% world-wide air travel discount.

Why not write us today, describing your interests and qualifications in any of the areas above. Address: Dr. Charles Carroll, Pan American World Airways, Inc., P. O. Box 4886, Patrick Air Force Base, Fla. An Equal Opportunity Employer.



**OUTER MISSILES RANGE DIVISION
PATRICK AIR FORCE BASE, FLORIDA**

Key Staff Positions INFRA-RED & ELECTRO-OPTICAL SYSTEMS

**STARTING SALARY
TO \$18,000**

Technology in the Greater New York City area has created exciting new opportunities available immediately in the development of infrared and electro-optical systems for space and missile programs. Current activities include search and track systems, laser ranging, detection and guidance, etc. Future programs will include advanced development and application of LASERS for space technology.

These are key positions of the specialist and senior levels. There are salaries to \$18,000. Excellent opportunity for rapid advancement. Deep level resume is absolutely essential. We will accept immediate entry.

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URGENT PHYSICAL SCIENCE DEVELOPMENT
Electronics, optics, and space technology. Immediate openings in the development of infrared and electro-optical systems for space and missile programs. Current activities include search and track systems, laser ranging, detection and guidance, etc. Future programs will include advanced development and application of LASERS for space technology.

AIRLINE STAFF OF ENGINEERING
Experienced in the field of engineering. Immediate openings in the development of infrared and electro-optical systems for space and missile programs. Current activities include search and track systems, laser ranging, detection and guidance, etc. Future programs will include advanced development and application of LASERS for space technology.

TECHNICAL STAFF OF ENGINEERING
Experienced in the field of engineering. Immediate openings in the development of infrared and electro-optical systems for space and missile programs. Current activities include search and track systems, laser ranging, detection and guidance, etc. Future programs will include advanced development and application of LASERS for space technology.

ADDITIONAL STAFF OF ENGINEERING
Experienced in the field of engineering. Immediate openings in the development of infrared and electro-optical systems for space and missile programs. Current activities include search and track systems, laser ranging, detection and guidance, etc. Future programs will include advanced development and application of LASERS for space technology.

POSITIONS WANTED
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Competent men for your staff? . . . employment? . . . or are you looking for — or offering — a business opportunity of special interest to readers of this publication? You can get their attention — through an advertisement in the Employment Section of AVIATION WEEK.

[illegible]

AVIATION WEEK and SPACE TECHNOLOGY, December 3, 1982



100 kW CW

1.7- 2.4 Gc

FOR DEEP SPACE COMMUNICATIONS

Varian Associates' new VA-858 CW amplifier klystron offers the highest known power in S-band for deep-space communications. Developed by the same team of engineers who brought the industry the highest power in X-band, the VA-858 is conservatively rated at 100 kW, and in actual continued operation has delivered in excess of 175 kW. The VA-858 is available in four models. Tubes can be tuned for high gain, high efficiency, or wide bandwidth. With suitable stagger tuning, a 3 db bandwidth of 20 Mc can be achieved, with a power gain of 50 db. Tuning range of each tube is 150 Mc below 2 Gc, and 200 Mc above 2 Gc. Small size of the tube is ideal for antenna mounting.

If your deep-space or satellite project requires such exemplary tubes, Varian has (or can design) the tube for you. Write Tube Division.

CHARACTERISTICS:	SYNCH TUNED	HIGH EFF. TUNED	BROAD- BAND TUNED
Power Output (kW)	103	122	122
Drive Power (mW)	35	350	1000
Gain (db)	65	55	51
Efficiency (%)	35	41	41
Bandwidth, 3 db (Mc)	8.5	15	21
Beam Voltage (kVdc)	35	35	35
Beam Current (Ade)	8.5	8.5	8.5



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